



LEVEL CROSSING REMOVAL PROJECT

PRECEDENT STUDY

7 March 2016

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INTRODUCTION

PURPOSE

Over the next eight years, the State Government will deliver a coordinated program to remove 50 of the worst level crossings in Melbourne, improving safety and urban amenity in local communities whilst improving the efficiency of the local transport network and creating thousands of jobs. It represents one of the biggest urban design and transport architecture programs in Melbourne's history, affecting many activity centres across the city.

This precedent study provides background information for the program by illustrating precedents of relevant rail and road projects from around the world. It includes examples of rail over and rail under, road over and road under, good and bad, old and new, local, national and international precedents.

These precedents will be used to inform assessments of different design outcomes, noting that each level crossing site requires specific consideration in relation to a range of issues including engineering challenges, local environment and urban design objectives.

REPORT STRUCTURE

The document has been organised into four chapters:

Melbourne Precedents

This chapter presents precedents of rail and road projects in Melbourne from the last century. These include recent grade separation rail projects (e.g. Nunawading, Mitcham, Springvale, Epping and South Morang Stations), older grade separation rail projects in established suburbs (e.g. Balaclava, North Richmond and Glenferrie Stations), unsuccessful grade separation projects (e.g. Warrigal Road at Oakleigh) and major road projects (e.g. Eastlink, Peninsula Link and CityLink).

Australian Precedents

This chapter identifies relevant projects from around Australia including integrated activity centre development (e.g. Rouse Hill) and higher density transit-oriented development (e.g. Chatswood).

International Precedents

This chapter presents international projects with the positive use of public space beneath elevated structures (e.g. Sylvia Park, Buffalo Bayou Promenade, A8erna), recently developed elevated stations (e.g. Brentwood Skytrain, Randstad Rail Station), older elevated rail precincts undergoing rejuvenation (e.g. The Underline) and elevated stations in historic precincts (e.g. Hoxton Station, Zurich Viaduct Project).

Network Precedents

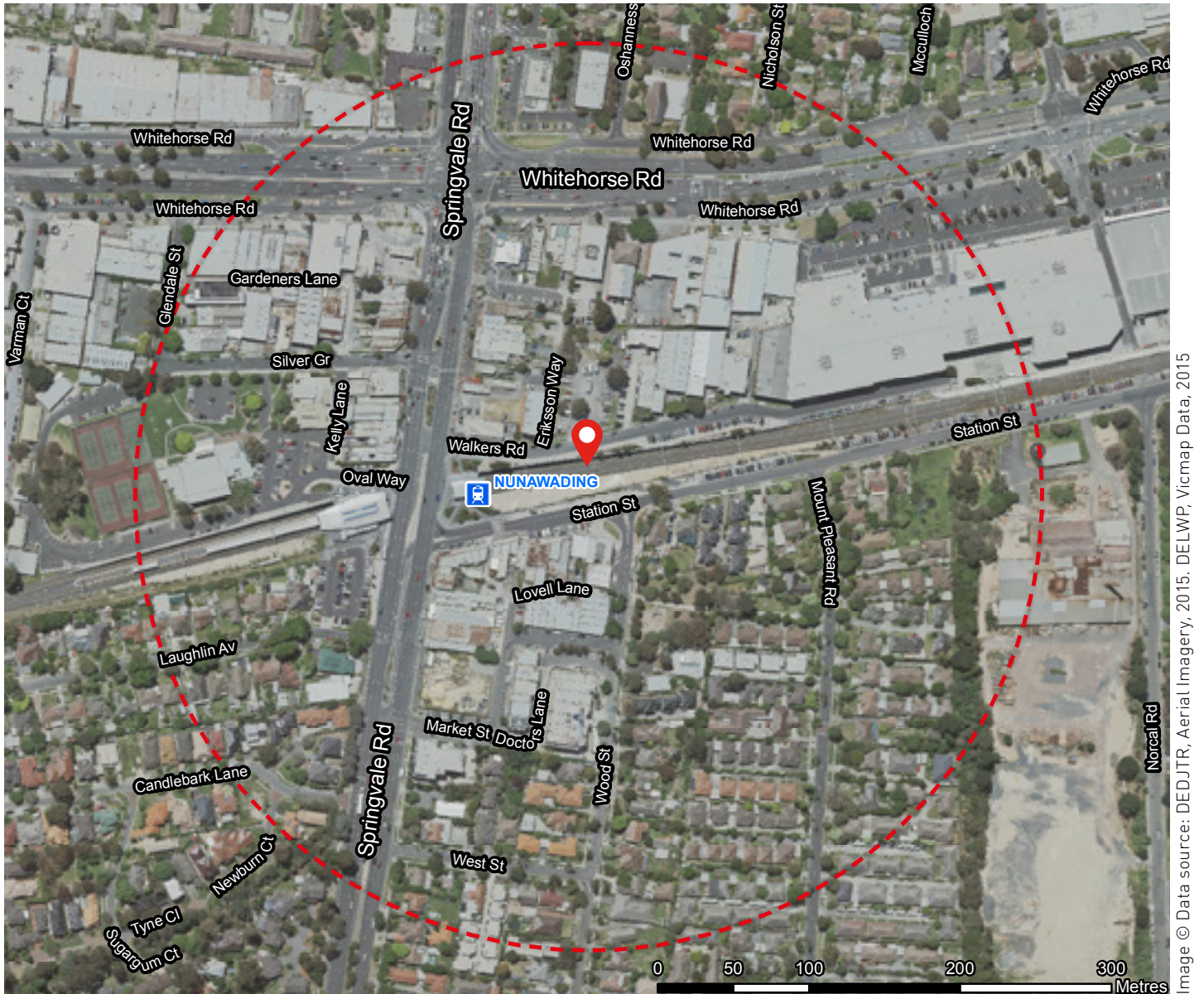
The final chapter illustrates networks or major network extension projects from around the world.



MELBOURNE PRECEDENTS

Nunawading Station

Melbourne



Addressing the Springvale Road level crossing was a key part of the Victorian State Government's AU\$38bn transport plan. In 2010 the railway line was lowered to allow it to pass under the highway. The structures were broken into individual elements to speed up construction.



Figure M 1 Street level



Figure M 2 View from the street



Figure M 3 Platform



Figure M 4 View from the street



Figure M 5 Street level

Mitcham Station

Melbourne

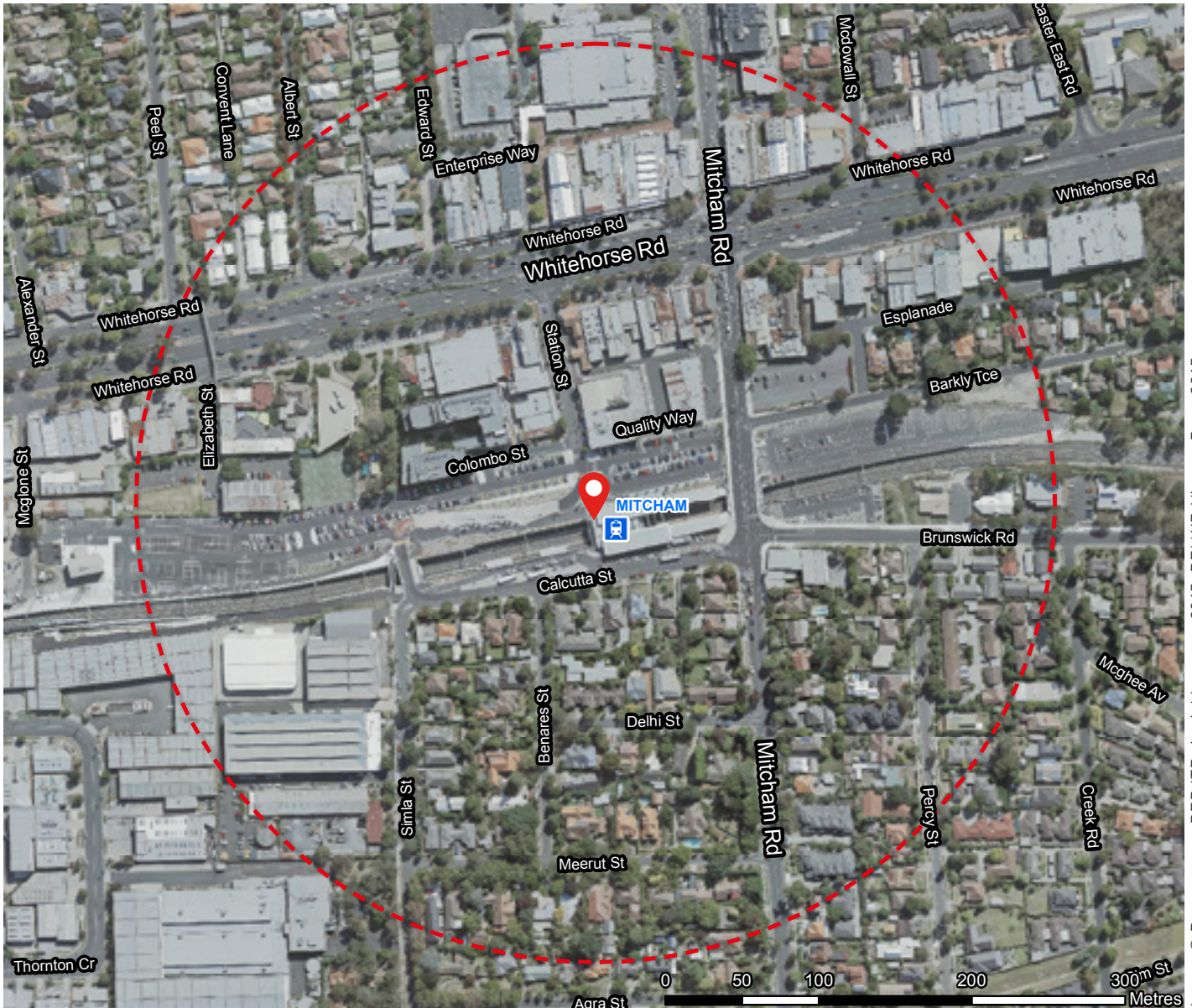


Image © Data source: DEDJTR, Aerial Imagery, 2015. DELWP, Vicmap Data, 2015

The redevelopment of Mitcham Station in 2014 created a new below-ground premium station, including car park, bike facilities and bus interchange. The project saw the removal of the level crossings on Mitcham Road and Rooks Road.



Figure M 6 View from the street



Figure M 7 View from the street



Figure M 8 Platforms



Figure M 9 Bus interchange



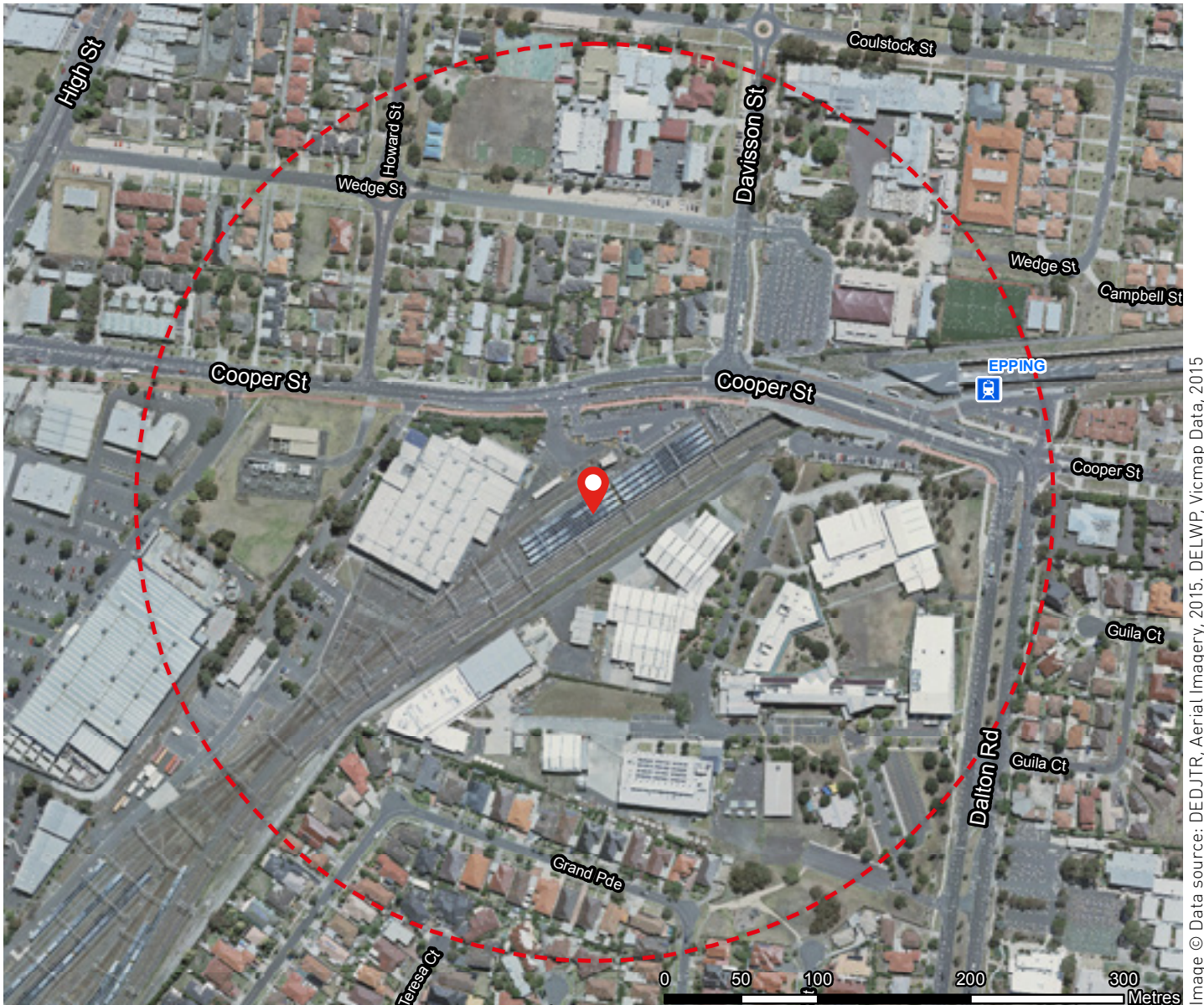
Figure M 10 Platforms



Figure M 11 Bus interchange

Epping Station

Melbourne



Epping Station's redevelopment in 2011 was part of the \$640 million South Morang Rail Extension Project. The new island platform north of Cooper Street was built below ground level.



Figure M 12 View from street



Figure M 13 View from street



Figure M 14 Platform



Figure M 15 Intermodal connections



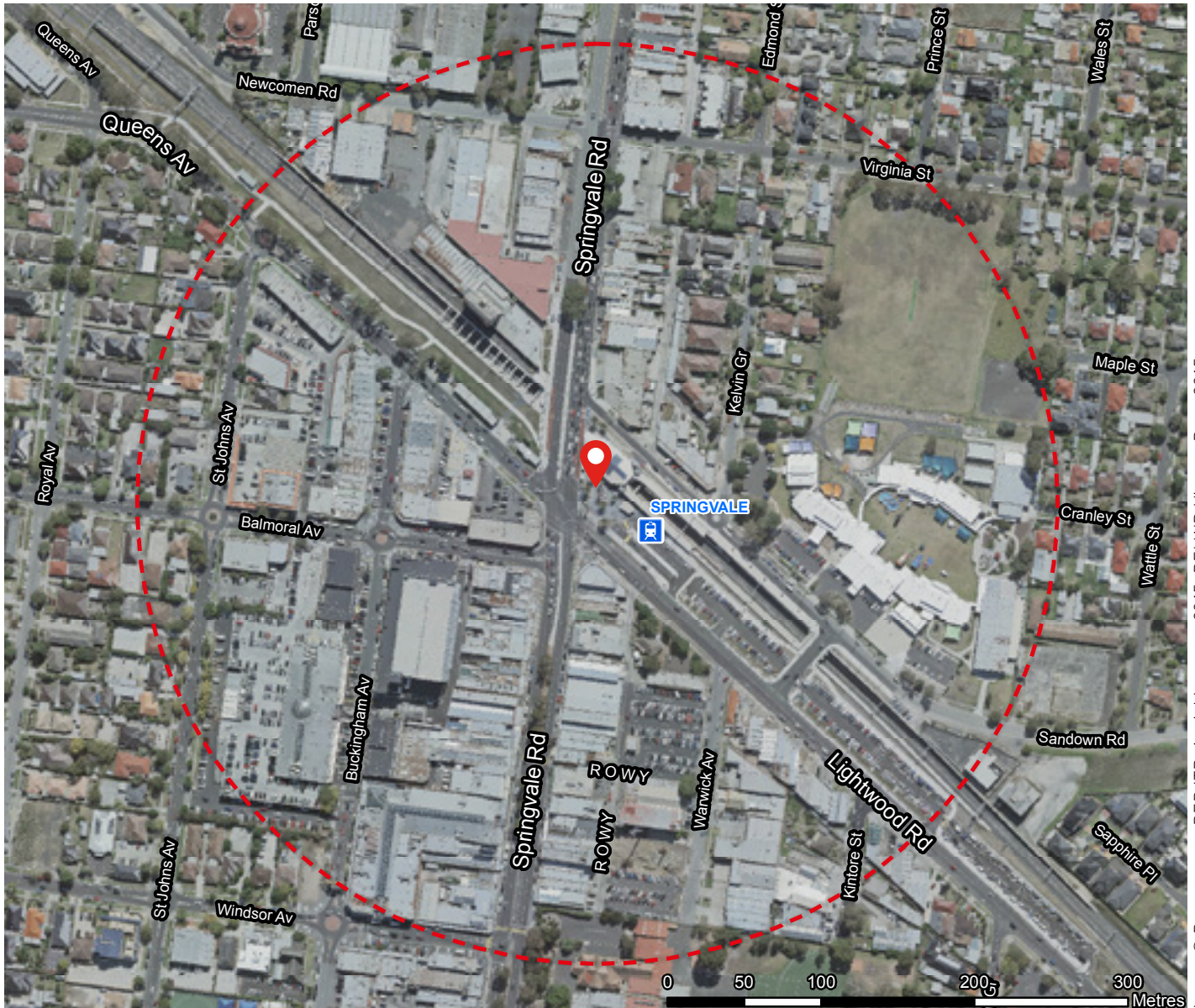
Figure M 16 Car parking



Figure M 17 Street level

Springvale Station

Melbourne



Springvale Station was rebuilt below street level in 2014, eliminating the Springvale Road level crossing immediately north of the station.



Figure M 18 Street level model



Figure M 19 Street frontage



Figure M 20 Platform



Figure M 21 View from the street



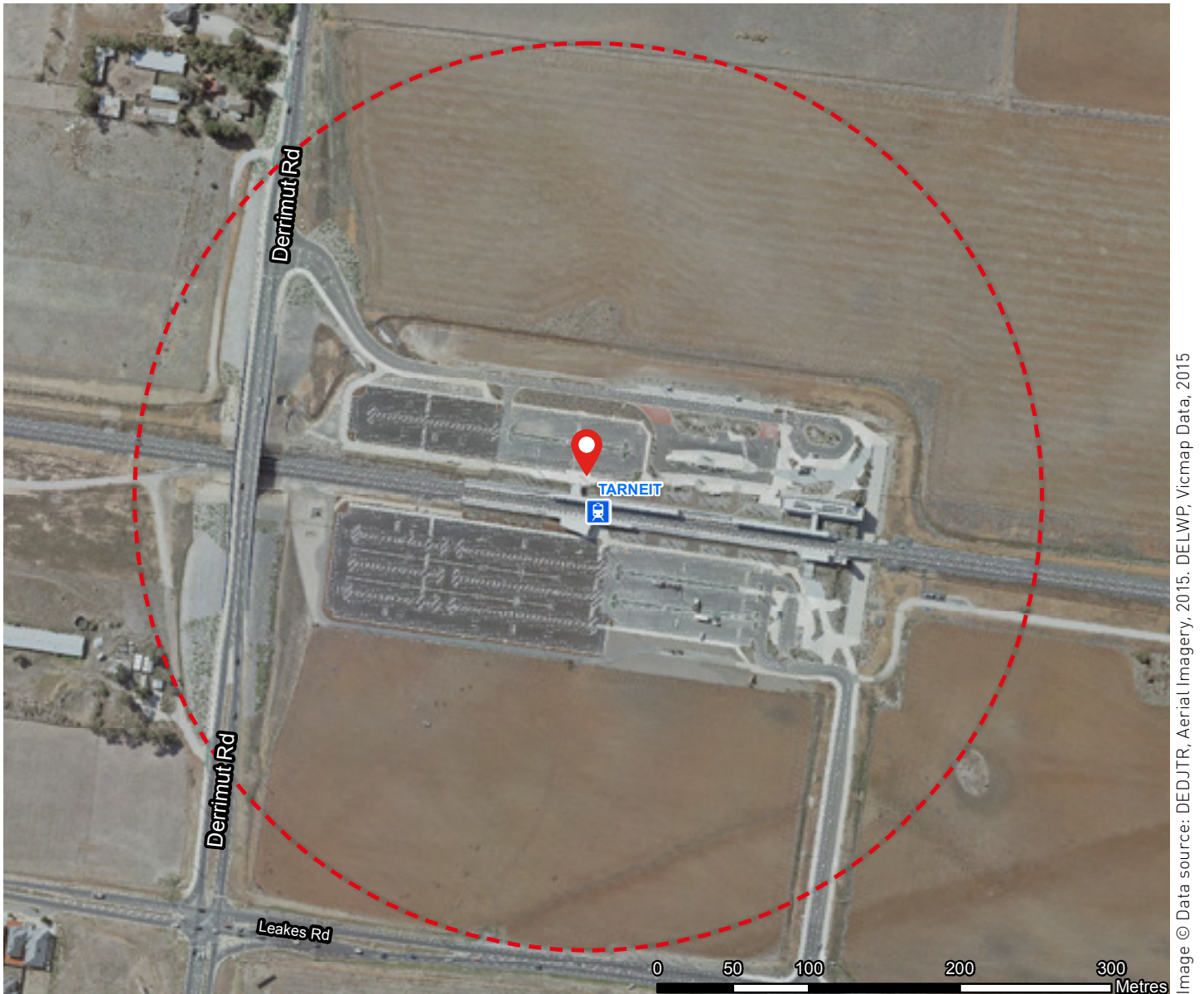
Figure M 22 Bus stop and station



Figure M 23 Pedestrian underpass

Tarneit Station

Melbourne



Tarneit Station was built as part of the Regional Rail Link project and opened in June 2015.



Figure M 24 Platform



Figure M 25 Tarneit Road grade separation



Figure M 26 Tarneit Road grade separation



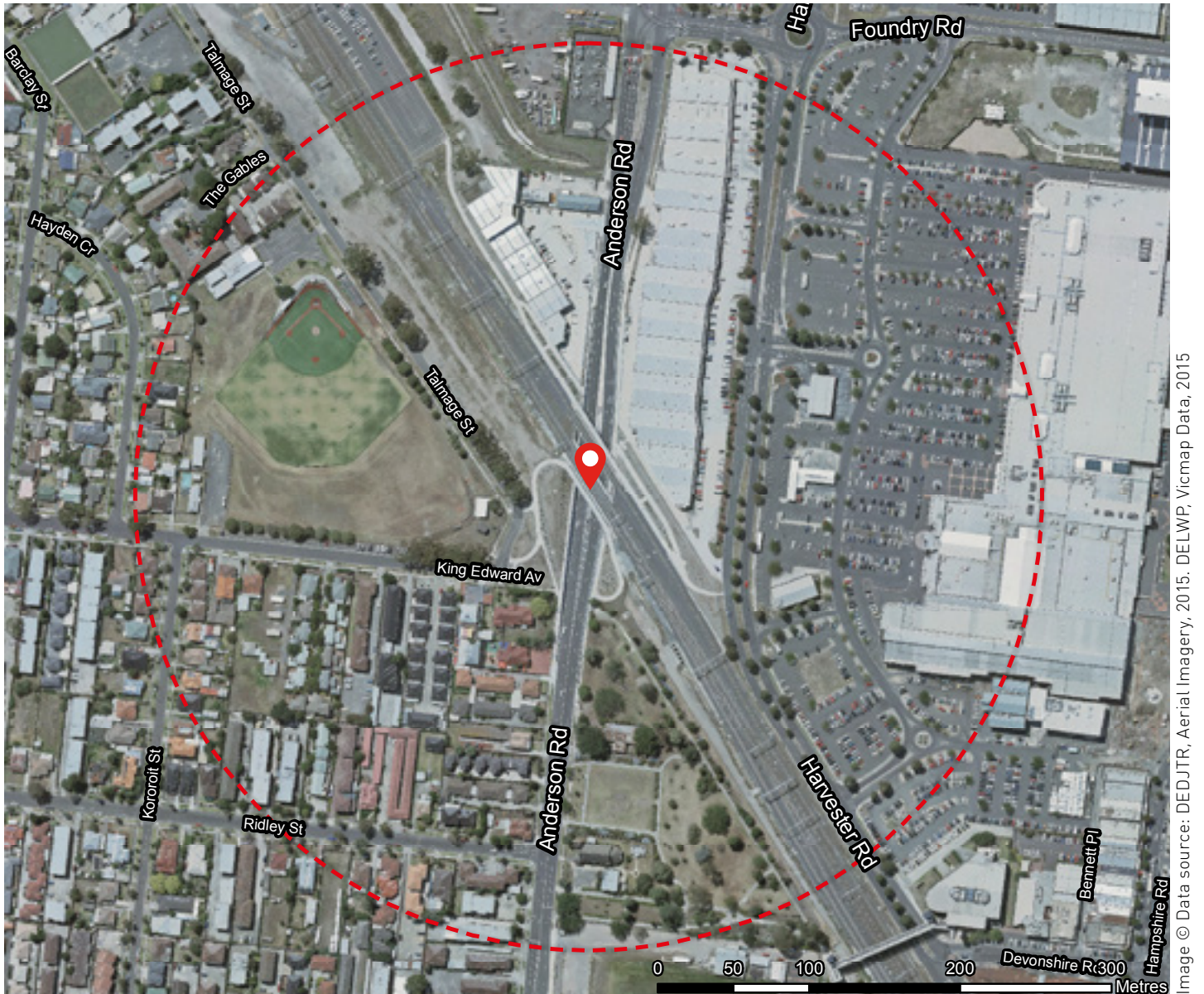
Figure M 27 Platform



Figure M 28 Street level

Anderson Road North

Melbourne



As part of the Regional Rail Link project, the Anderson Road level crossing (near King Edward Avenue and HV McKay Gardens in Sunshine, on the Bendigo, Sunbury and freight lines) was replaced by a road underpass in 2014.



Figure M 29 Anderson Road north underpass



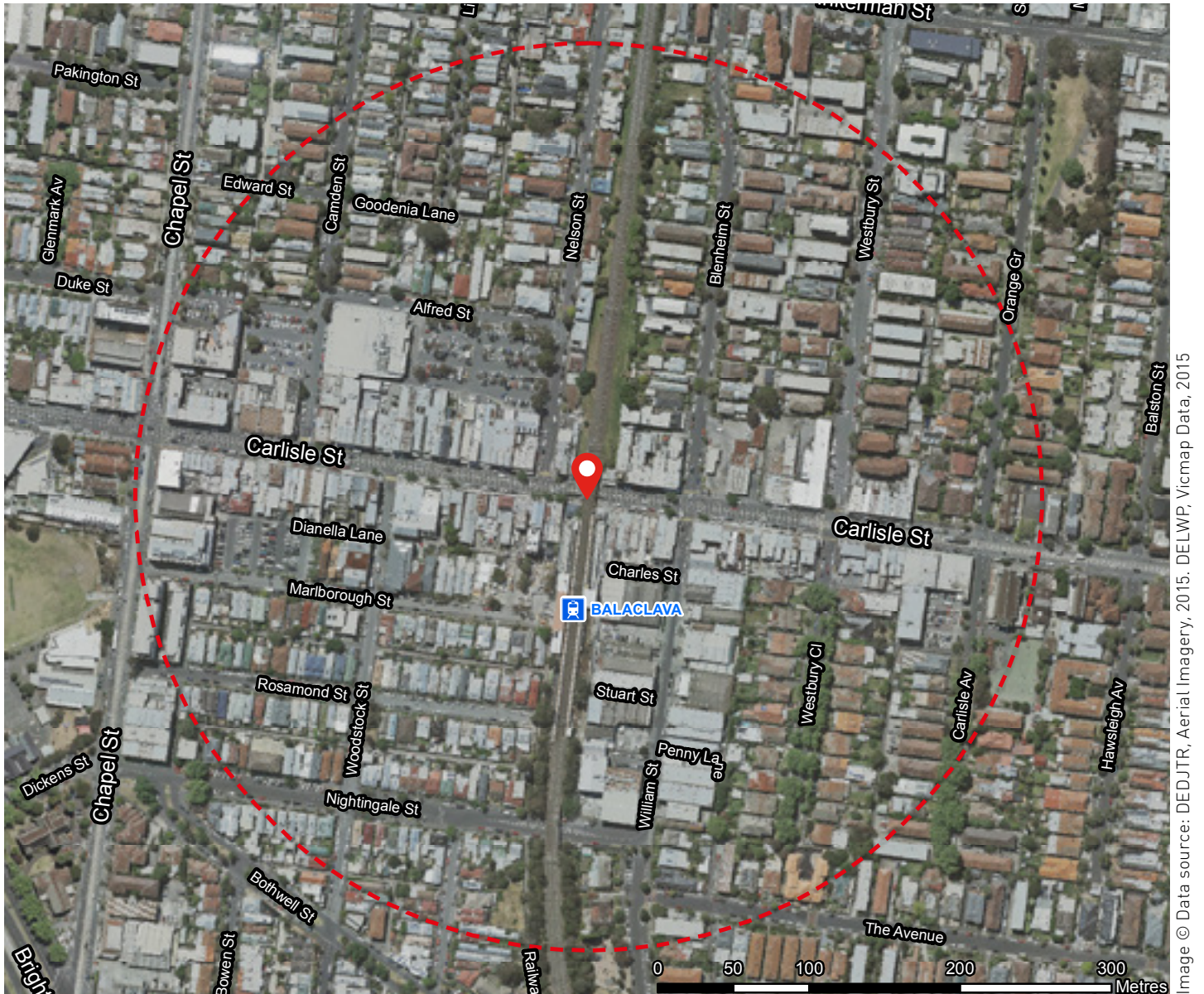
Figure M 30 Aerial view of Anderson Road north underpass



Figure M 31 Anderson Road north underpass

Balaclava Station

Melbourne



Balaclava Station is an elevated station located above the Carlisle Street rail overpass. The station was redeveloped and upgraded to a premium station in October 2014, however the rail overpass was not altered at that time.



Figure M 32 Grade Separation at Carlisle St



Figure M 33 Grade Separation at Carlisle St



Figure M 34 View from the street



Figure M 35 Under the viaduct

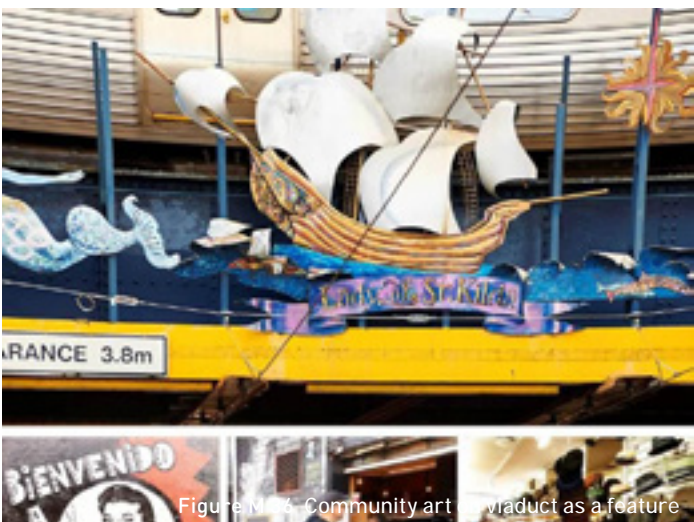


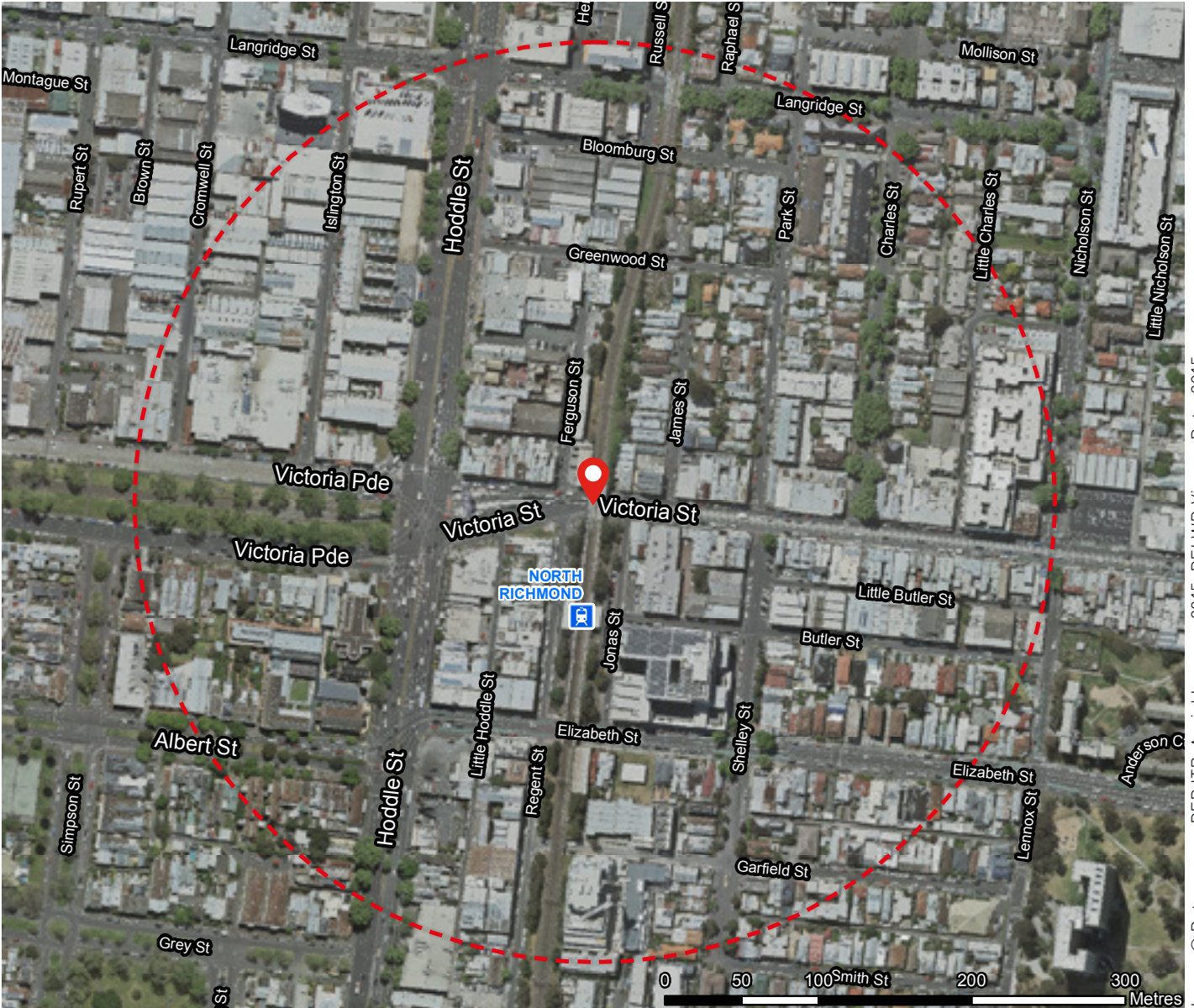
Figure M 36 Community art viaduct as a feature



Figure M 37 Grade Separation at Carlisle St

North Richmond Station

Melbourne



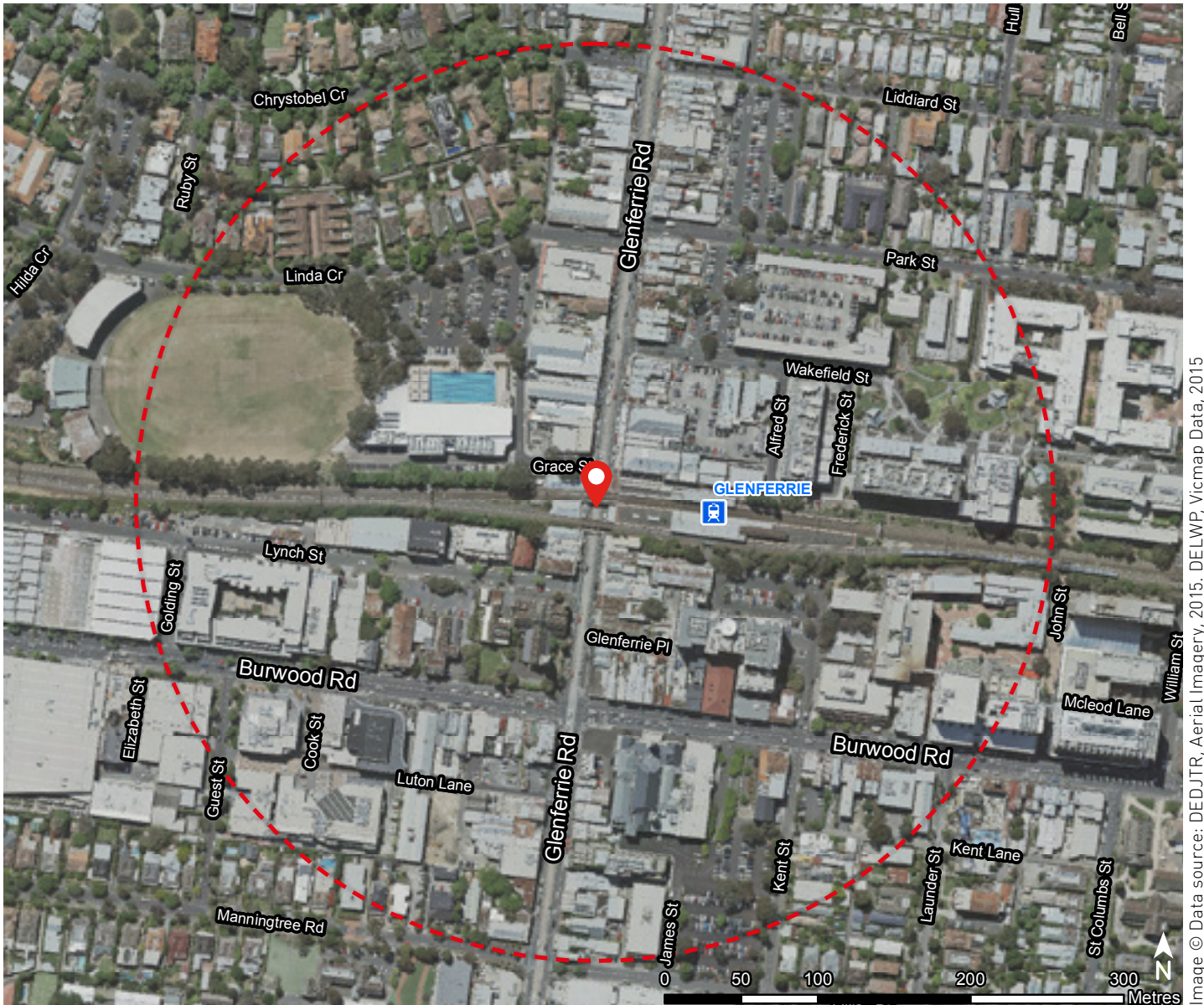
The elevated railway was built in 1901 over Victoria Street, Melbourne. Underneath the bridge on Victoria Street, trams, buses, pedestrians and road traffic travel freely without stopping for trains.

The bridge acts as a gateway to the Victoria Street area with public art tiger motifs. The vegetation on the embankment provides buffer planting through the urban setting.



Glenferrie Station

Melbourne



Glenferrie Station in Melbourne is listed on the Victorian Heritage Register (H1671). The railway line was originally raised over Glenferrie Road in 1916.

This is an elevated rail-over-road project. The two rail bridges are split to allow air, light and rain between the bridges to the pedestrians, traders and road users below.



Figure M 43 Glenferrie Road

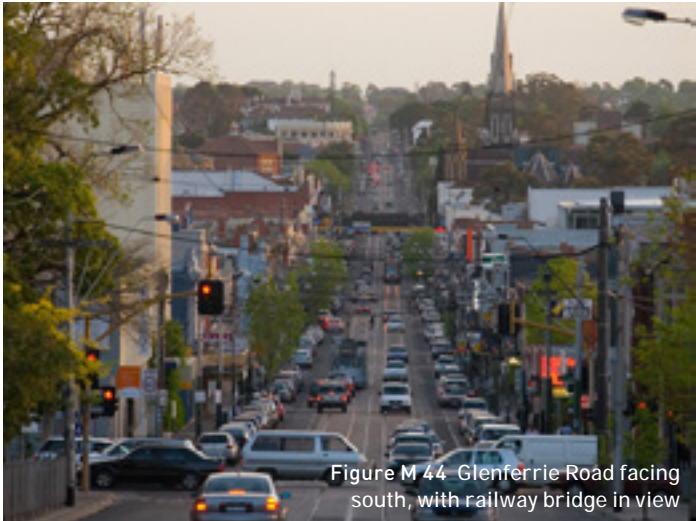


Figure M 44 Glenferrie Road facing south, with railway bridge in view



Figure M 45 Glenferrie Road below Glenferrie Station



Figure M 46 Glenferrie Festival



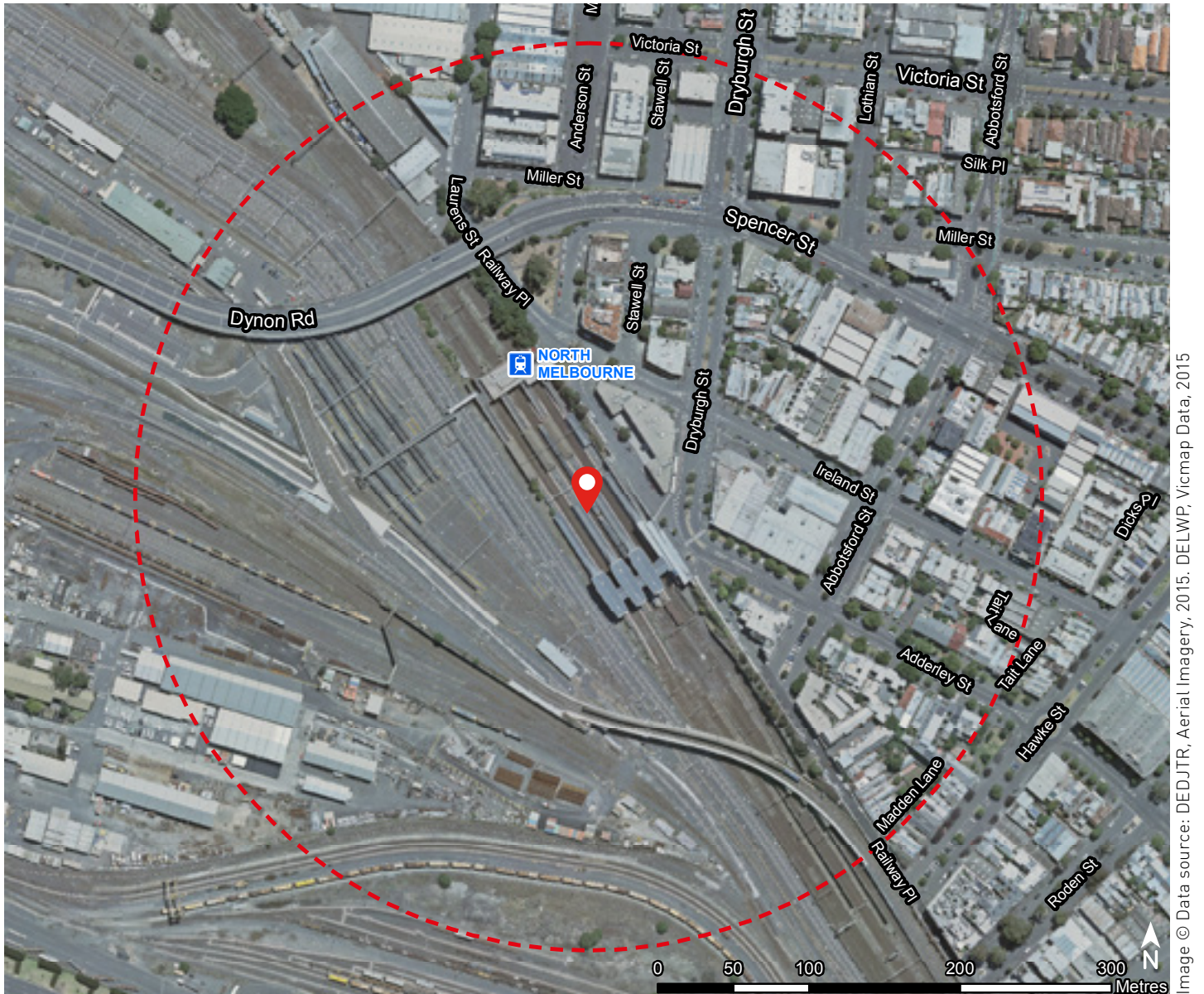
Figure M 47 Shops between the rail bridges



Figure M 48 Platforms

North Melbourne Station

Melbourne



North Melbourne Station opened in 1859 and is a major interchange station servicing the Craigieburn, Flemington Racecourse, Sunbury, Upfield, Werribee and Williamstown lines. The premium station has undergone various expansions and renovations over the years.

The station was recently redeveloped in 2009 which included a new main entrance at the southern end of the station with escalators, stairs and lifts installed.



Figure M 49 North Melbourne Station platforms



Figure M 50 Pedestrian overpass



Figure M 51 Escalators



Figure M 52 Platforms

South Morang Station

Melbourne

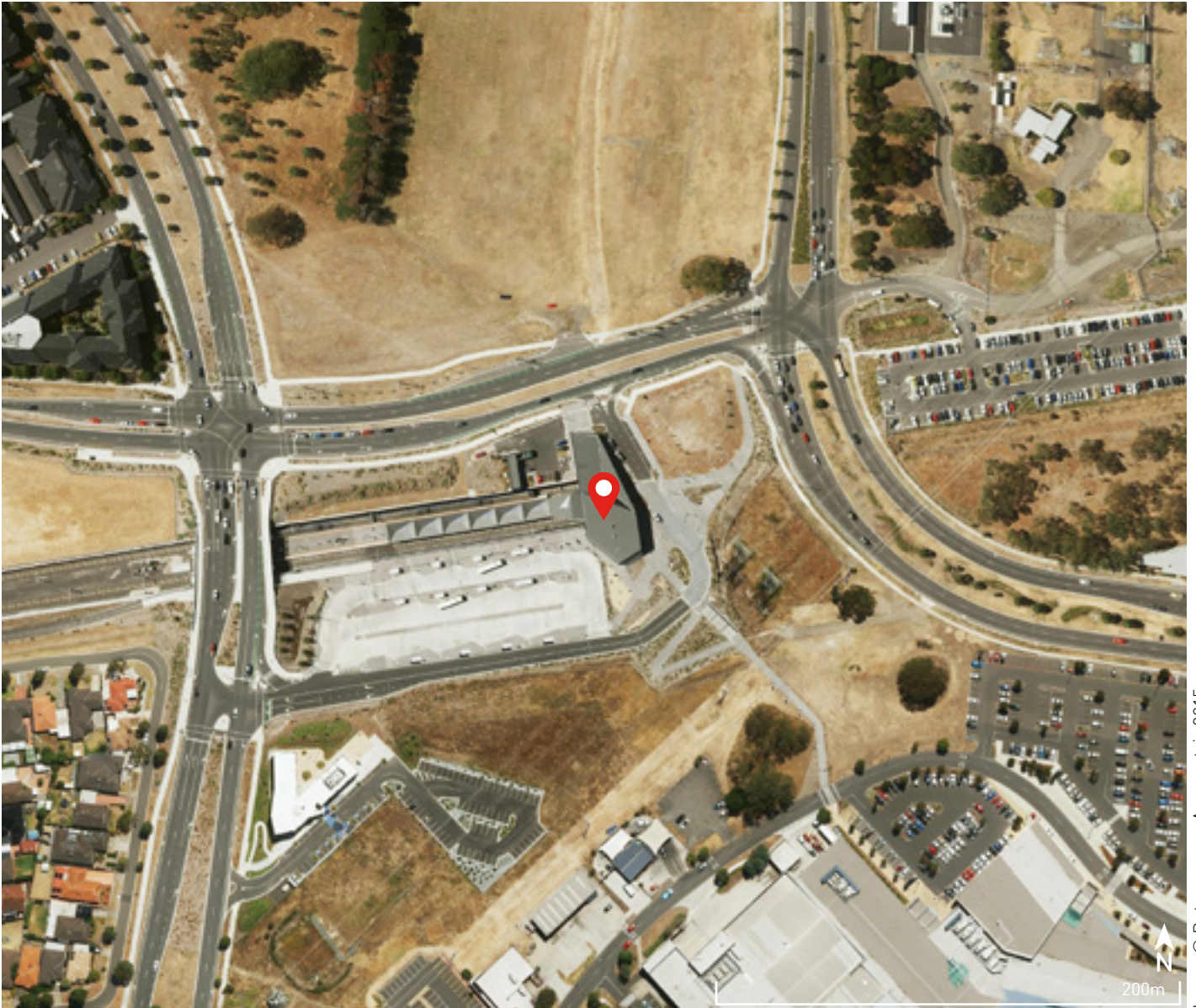


Image © Data source: Aerometrix 2015

South Morang station opened in April in 2012 and is the current terminus of the South Morang line. It is an example of a rail under station where the rail corridor runs under Civic Dr. The station is clad in steel panels, features a timber underside and is prominently sited.

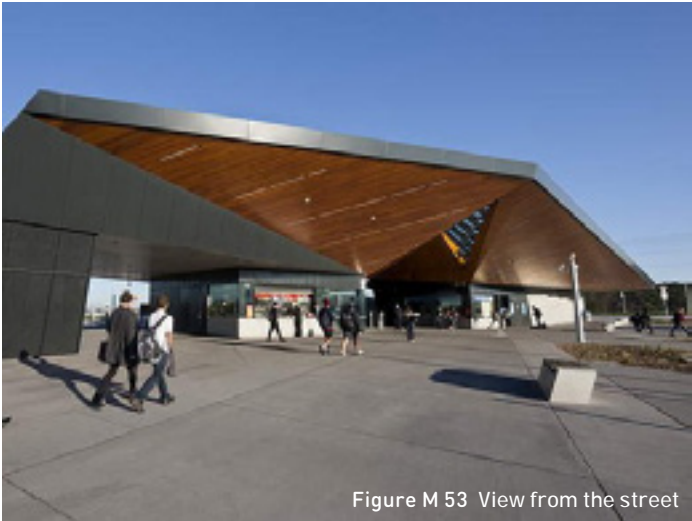


Figure M 53 View from the street



Figure M 54 Platforms

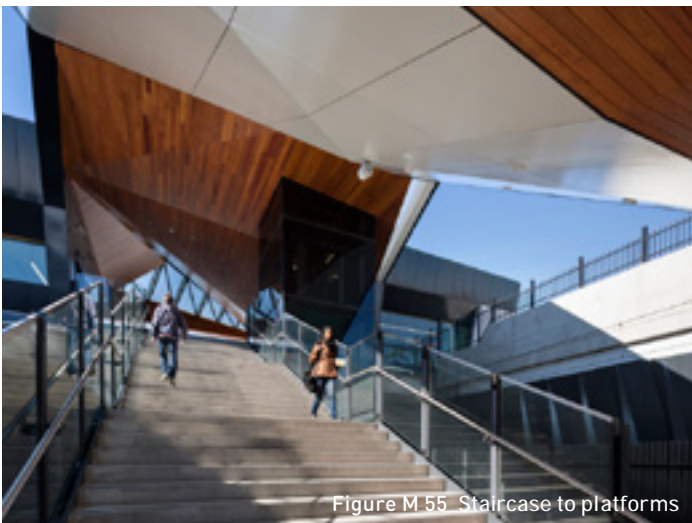


Figure M 55 Staircase to platforms



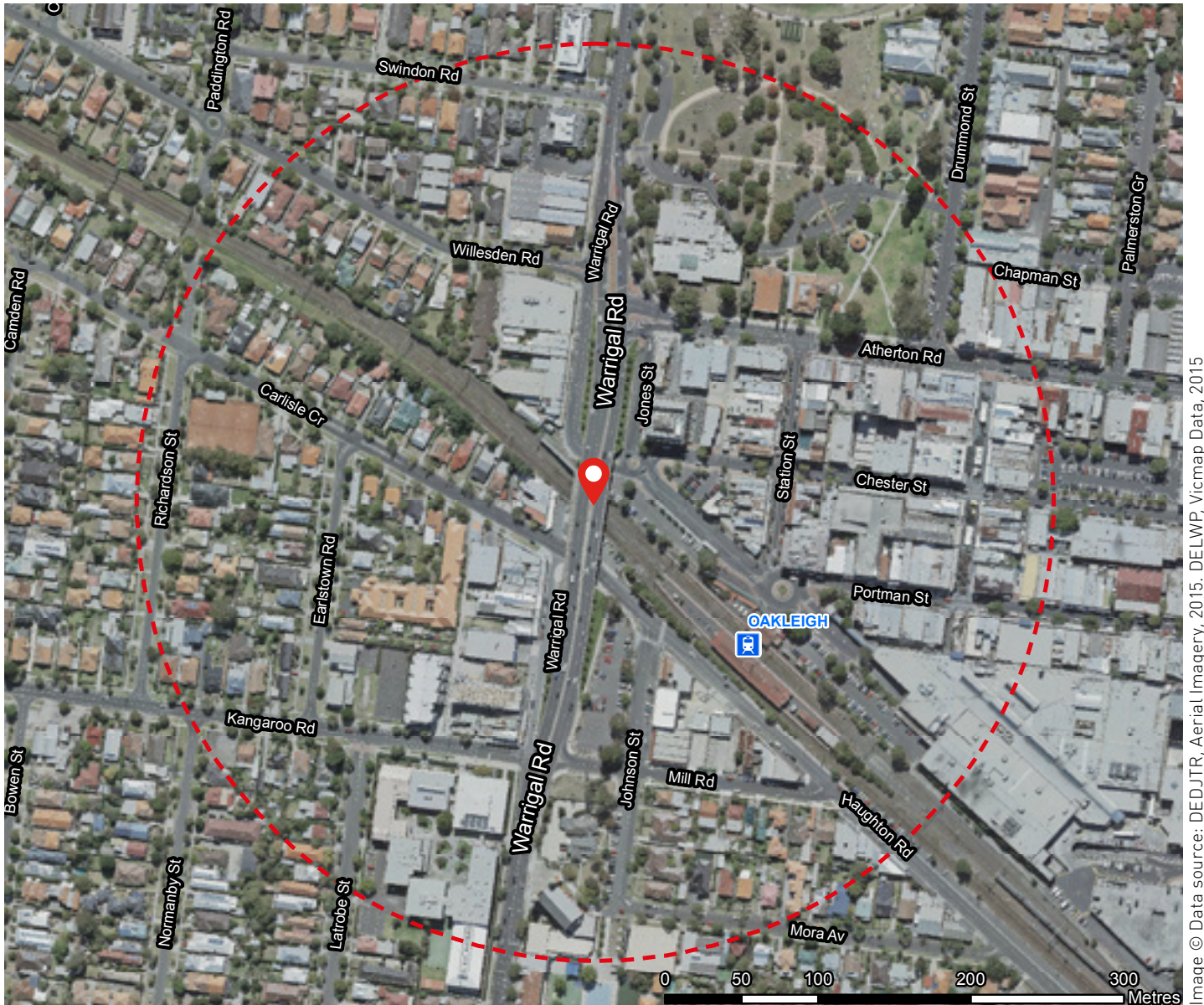
Figure M 56 Platform



Figure M 57 View from the street

Warrigal Road, Oakleigh

Melbourne



The elevated Warrigal Road which bridges over the Pakenham rail line is an example of a road over rail grade separation solution.



Figure M 58 View of at grade section of Warrigal Road and retaining wall of elevated section of Warrigal Rd looking north



Figure M 59 Pedestrian ramp which provides access up to Warrigal Rd from Burlington St



Figure M 60 View under Warrigal Rd from Burlington St looking east

EastLink

Melbourne



Image © Data source: Terramatrix 2016 & Aerometrix 2016

The EastLink toll road is 39 km section of the Eastern Freeway (M3) which connects to the Monash, Frankston and Peninsula Link freeways.

The urban design of the tollway includes a strong colour palette and road art.

The artistic and architectural design is evident in the pedestrian overpasses, bridge balustrades and noise attenuation structures.

The extensive road landscaping was the largest landscaping program ever undertaken on any road project in Australia. Approximately 4 million native plants, shrubs and trees were planted in the EastLink landscape.

The EastLink trail provides pedestrians and cyclists with a shared 3m concrete path that follows the part of the route.



Figure M 61 Composite noise wall



Figure M 62 Eastlink trail



Figure M 63 Eastlink trail



Figure M 64 Eastlink



Figure M 65 Eastlink tunnel



Figure M 66 Eastlink overpasses



Figure M 67 Landscaping



Figure M 68 Overpass



Figure M 69 Artwork



Figure M 70 Pedestrian bridge



Figure M 71 Noise wall



Figure M 72 Eastlink



Figure M 73 Eastlink



Figure M 74 Surrounding landscape



Figure M 75 Artwork



Figure M 76 Eastlink

Peninsula Link

Melbourne



Peninsula Link is a 27 km road link between Eastlink and the Mornington Peninsula Freeway. The road features an array of permanent and temporary art installations. A partnership with Southern Way and McClelland Gallery & Sculpture Park sees semi-permanent sculptures commissioned every 2 years. The landscape architecture concept was influenced by the need to maximize natural plant regeneration.

The Peninsula Link shared use path contributes to the Frankston and Mornington Peninsula walking and cycling networks.

Signature elements incorporated into individual bridge colour palettes indicate the bridge's status along the freeway. For example a blue palette indicates a key intersection in the network and yellow indicates a secondary crossing. The design features aim to enhance legibility of the road and its location relative to the wider road network.



Figure M 77 Pedestrian bridge



Figure M 78 Noise walls



Figure M 79 Noise wall detail and viaduct



Figure M 80 Peninsula Link



Figure M 81 Noise wall detail and viaduct



Figure M 82 The King is Dead sculpture



Figure M 83 Peninsula Link



Figure M 84 Noise wall



Figure M 85 Peninsula Link



Figure M 86 Peninsula Link



Figure M 87 Noise wall



Figure M 88 Peninsula Link



Figure M 89 Operations and maintenance centre



Figure M 90 Peninsula Link

CityLink

Melbourne

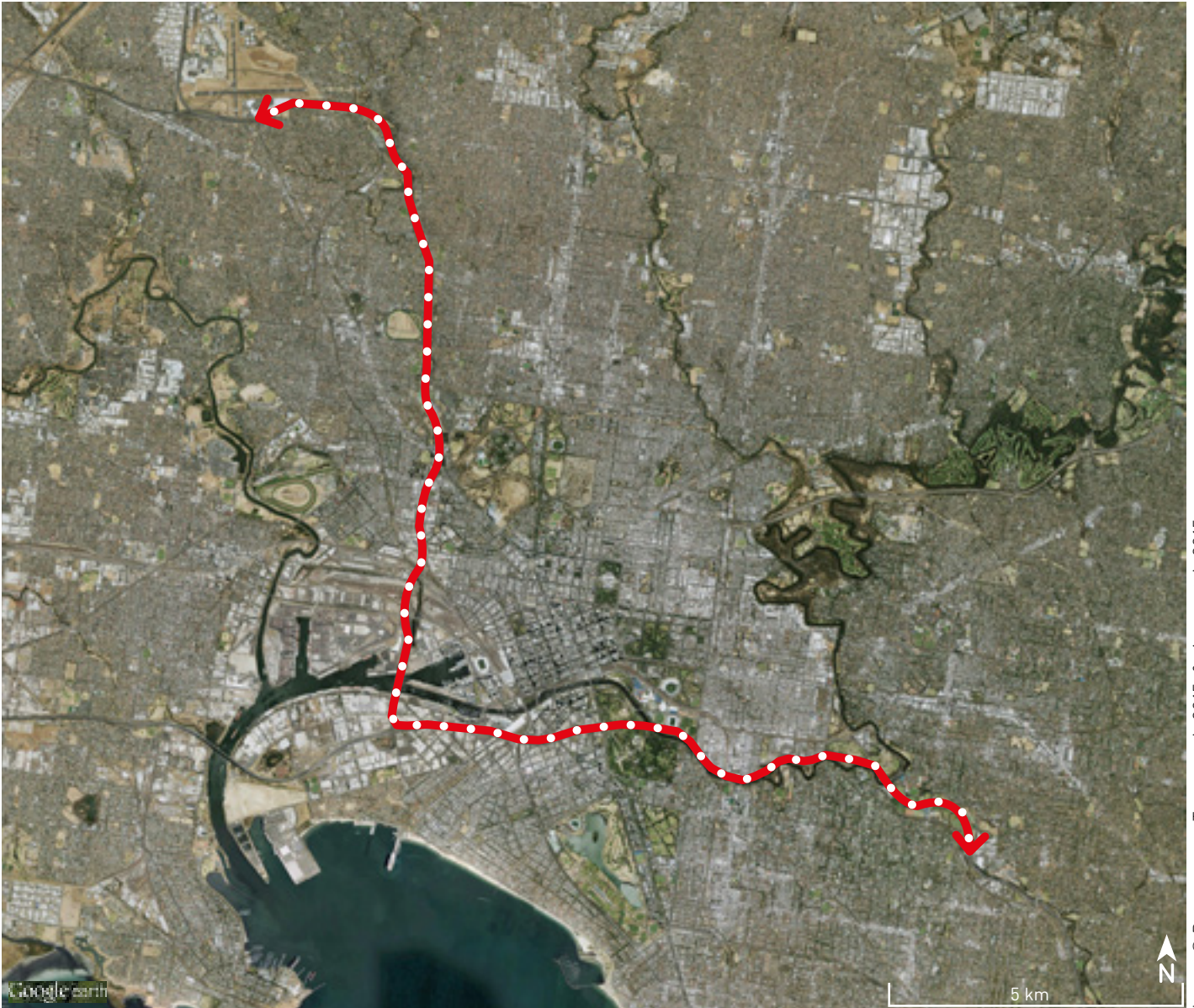


Image © Data source: Terramatrix 2015 & Aerometrix 2015

CityLink was built between 1996 and 2000 and is a network of tolled urban motorways in Melbourne, linking the West Gate, Tullamarine and Monash freeways. It incorporates the Bolte Bridge, Burnley Tunnel and provides a continuous, high-capacity road route to, and around, Melbourne's central business district.

Public art and gateway features include the iconic tube-like sound barrier in Flemington and a sculptural work called the Melbourne International Gateway.

The network includes provision for cyclists; however cyclists are excluded from riding the West Gate Freeway, the Bolte Bridge and over the West Gate Bridge.

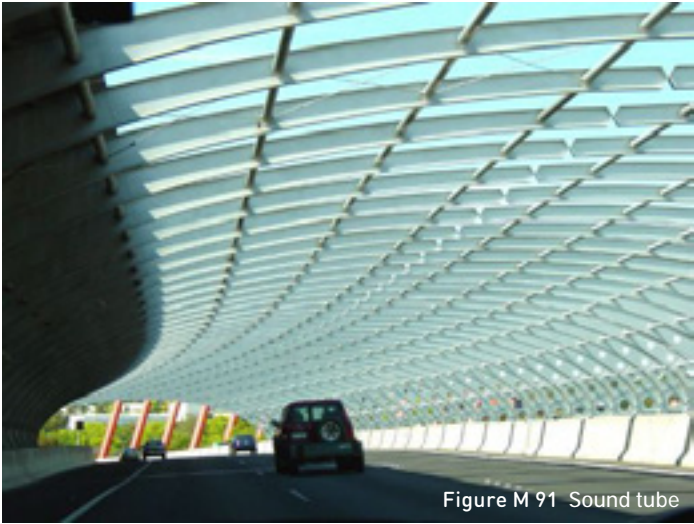


Figure M 91 Sound tube



Figure M 92 Sound tube

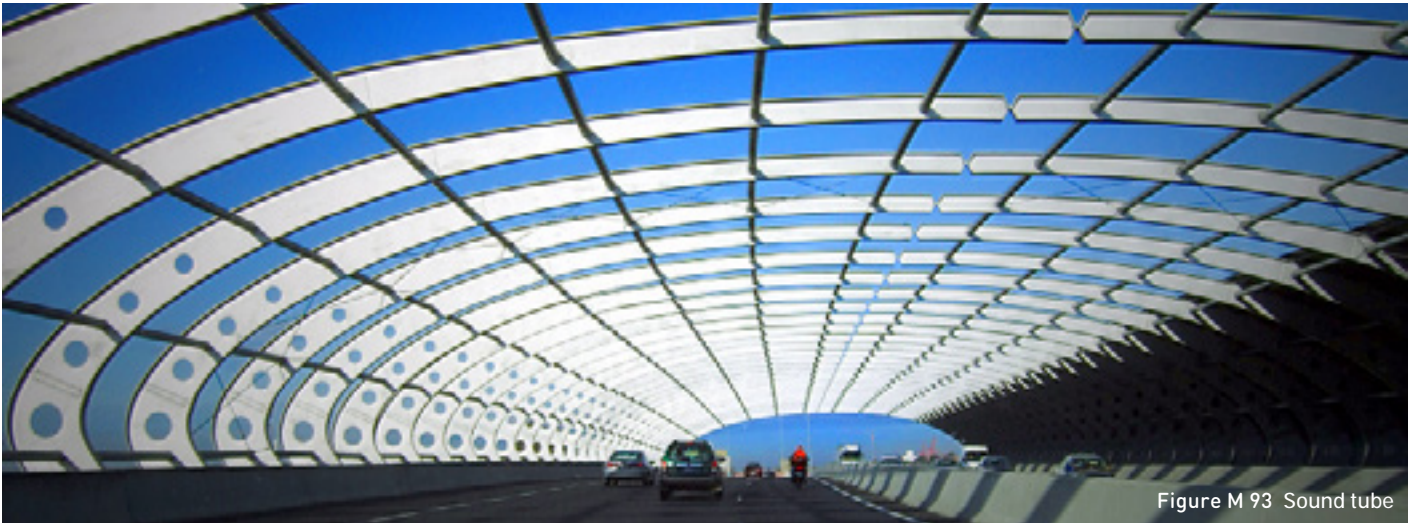


Figure M 93 Sound tube



Figure M 94 Gateway features



Figure M 95 Gateway feature

Jim Stynes Bridge

Melbourne

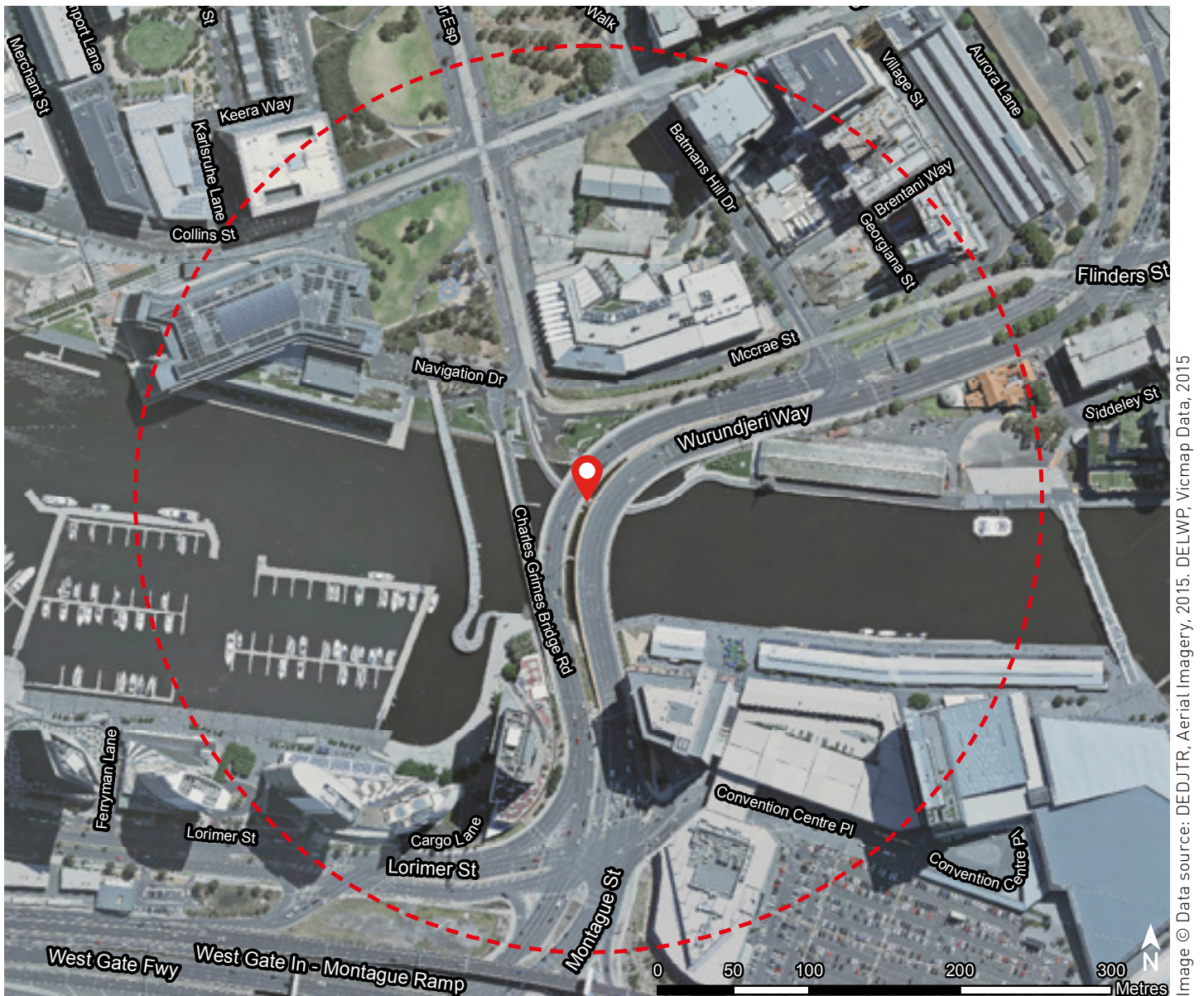


Image © Data source: DEDJTR, Aerial Imagery, 2015. DELWP, Vicmap Data, 2015

The Jim Stynes Bridge in Melbourne opened in 2014 in honour of the late footballer. The 120-metre-long horizontal suspension bridge arcs out 30 metres over the river.

This pedestrian and bicycle bridge cost \$15 million and provides a link for pedestrians, cyclists and commuters between Melbourne's CBD, and the key precincts of Docklands and Northbank.



Figure M 96 Jim Stynes Bridge



Figure M 97 Jim Stynes Bridge



Figure M 98 Jim Stynes Bridge



Figure M 99 Jim Stynes Bridge



AUSTRALIAN PRECEDENTS

Rouse Hill, NSW





Figure A 7 Street activity



Figure A 8 Built form



Figure A 9 Transport connections model



Figure A 10 Public realm



Figure A 11 Artist's impression

Chatswood Transport Interchange

Sydney



Image © 2015 Aerometrex

Chatswood Station was redeveloped to be Chatswood Transport Interchange with the construction of the Chatswood to Epping Line. The redeveloped station was raised to a viaduct level, allowing new road and pedestrian connections beneath the viaduct.

Chatswood Transport Interchange was developed with residential, retail and commercial buildings, above and adjacent to the station.

The project is an example of a rail over road grade separation and of transport associated development.



Figure A 12 Viaduct



Figure A 13 Pedestrian areas



Figure A 14 Street entry



Figure A 15 Aerial view



Figure A 16 Bus connections



Figure A 17 Station architecture



INTERNATIONAL PRECEDENTS

Sylvia Park, South Eastern Arterial Auckland, New Zealand



The 'SEART Park' is designed around the underside of 'South Eastern Arterial' motorway overpass SEART.

The project is an example of an urban design intervention which aims to invigorate a formerly underutilised space.



Figure I 1 Sylvia Park



Figure I 2 Sylvia Park



Figure I 3 Sylvia Park carparking



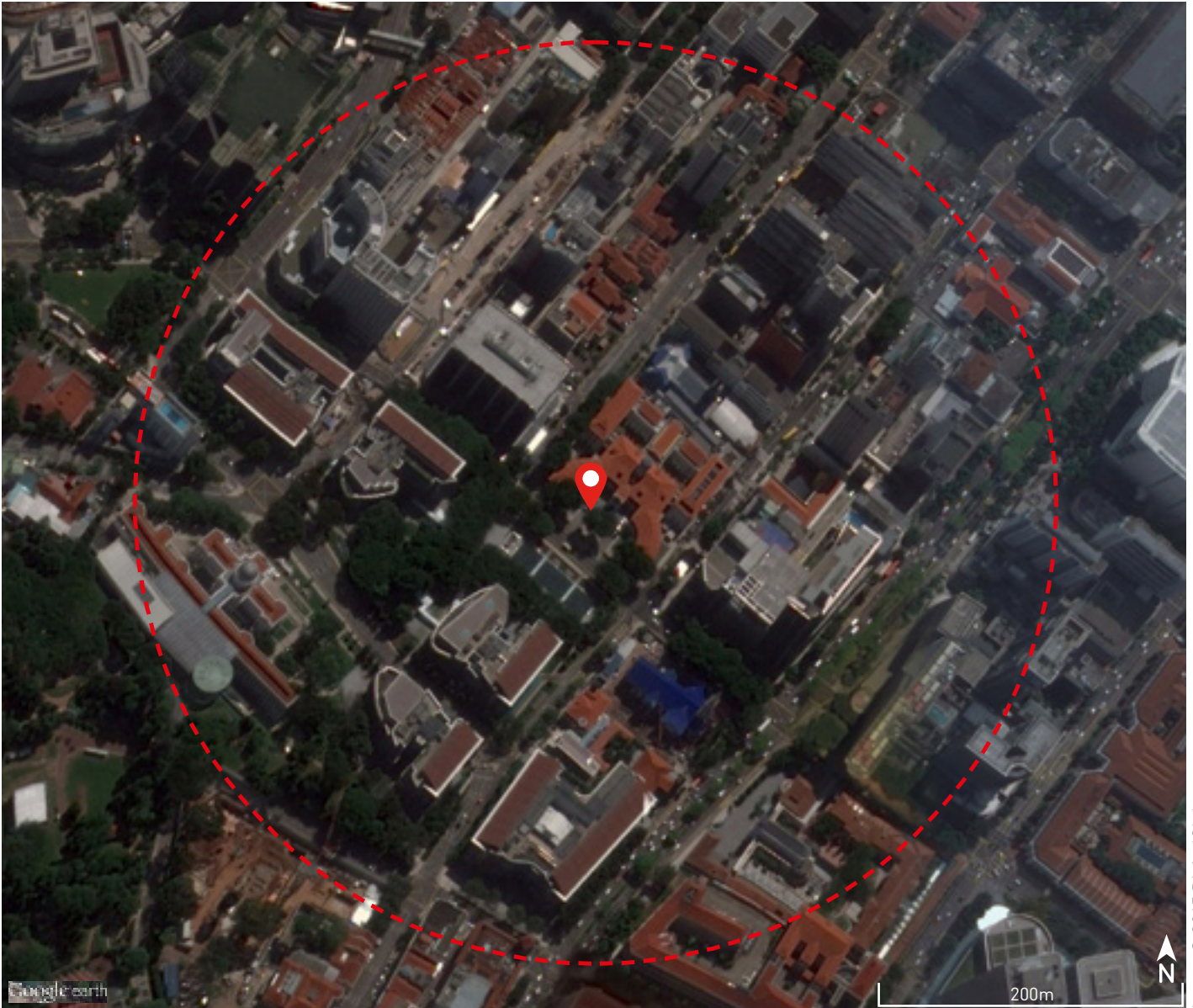
Figure I 4 Sylvia Park seating area



Figure I 5 Sylvia Park

Bras Basah Station

Singapore



Bras Bash is an underground station on the Circle Line in Singapore. At street level a large public space includes a water feature. Below street level, the station features an escalator atrium which has the water feature as a ceiling.

The project is an example of transport related public open space.



Figure I 6 Public open space and water feature



Figure I 7 View from above



Figure I 8 Station architecture



Figure I 9 Street entrance

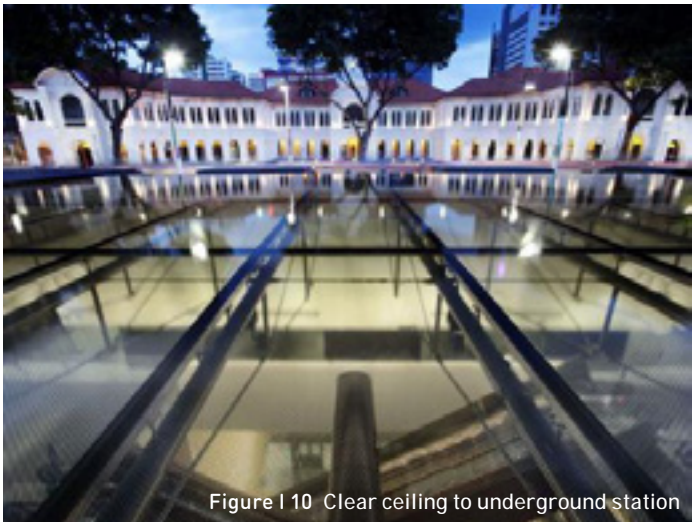


Figure I 10 Clear ceiling to underground station

The Underline

Miami, USA

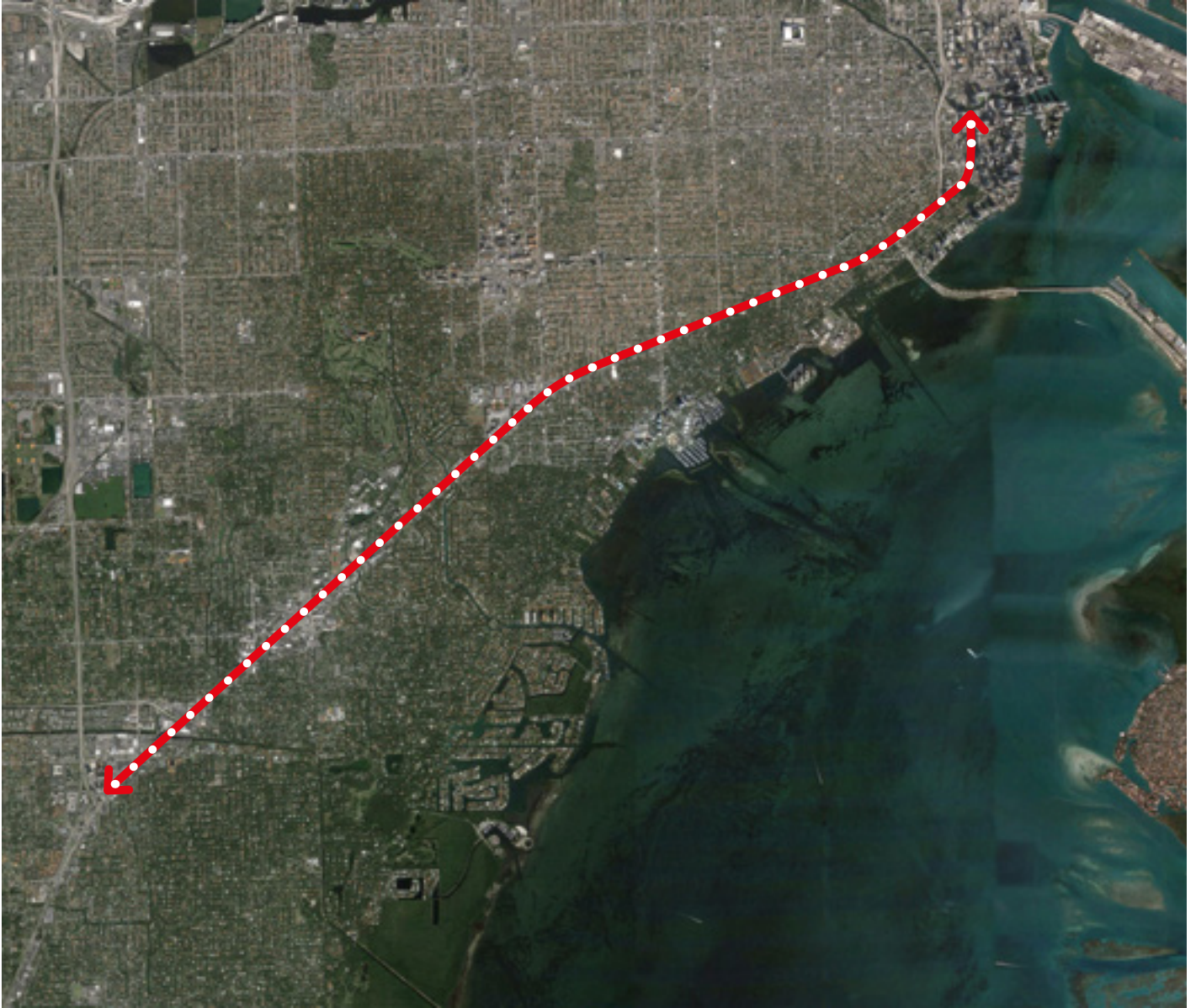


Image © Data source: SIO, NOAA, US Navy, NGA, GEBCO.

The Underline initiative aims to transform the underutilised 16 kilometre stretch under Miami's MetroRail into a linear park and urban trail. The vision is to create a world-class trail and living art destination that connects communities, provides an easily accessible place to exercise, creates over a hundred acres of open space with restored natural habitats and attracts development along the US1.

The project is at the Master Plan stage and is planned to be completed by 2026, depending on funding.



Figure I 11 Existing path



Figure I 12 Proposed path



Figure I 13 Existing path



Figure I 14 Proposed path



Figure I 15 Existing path



Figure I 16 Proposed path

Buffalo Bayou Sabine Promenade

Houston, USA

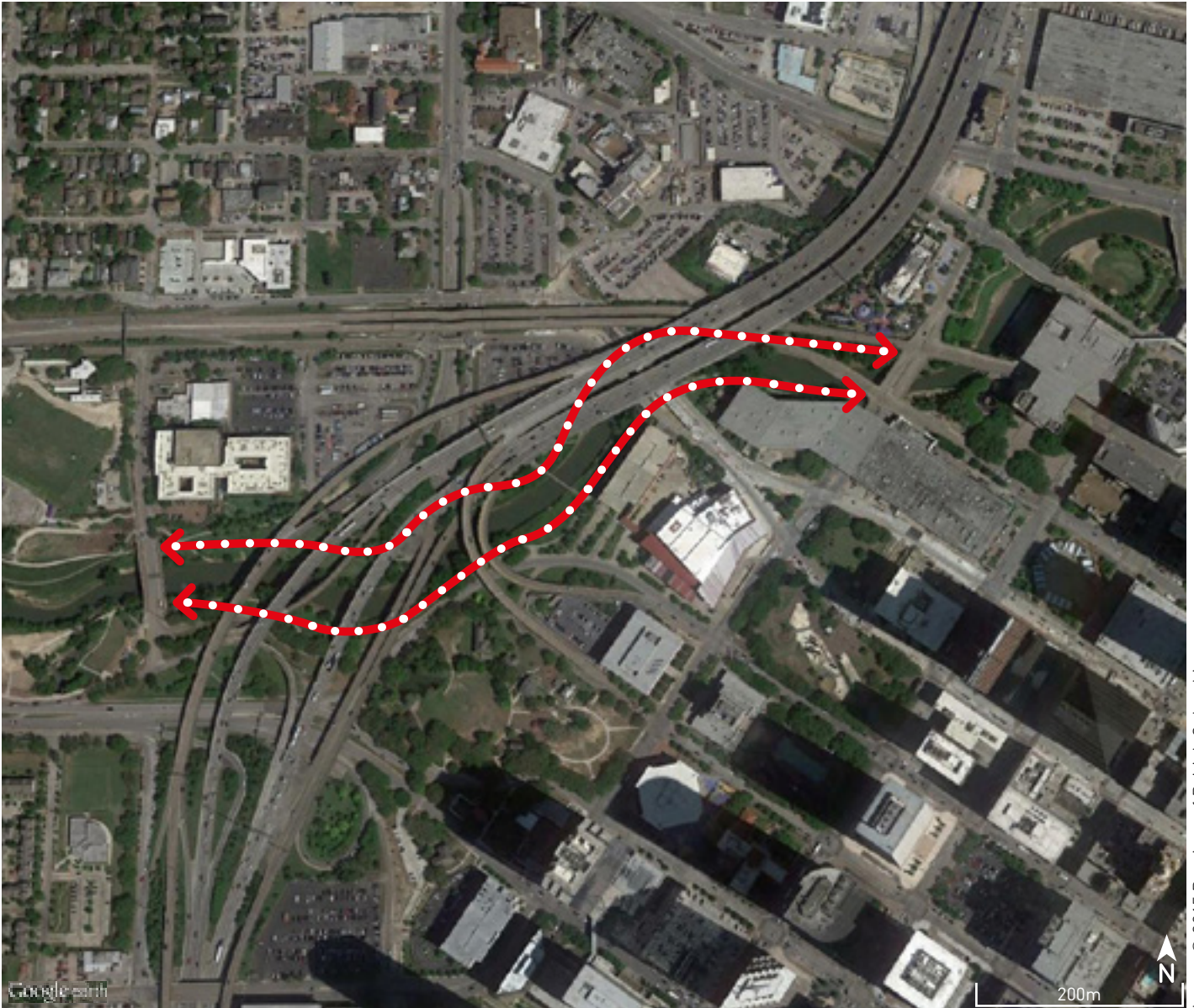


Image © 2015 Province of British Columbia

The Buffalo Bayou Promenade connects Houston's city core to the river park, under and through an area laden with roads and bridges. The Promenade project added 23 acres of parkland in close proximity to Houston's downtown area.

A wide variety of design solutions were employed to create the pedestrian friendly environment. A large focus was placed on pedestrian safety, particularly for night time.



Figure I 17 Lighting design



Figure I 18 Sabine Promenade hike and bike trails



Figure I 19 Sabine Promenade hike and bike trails



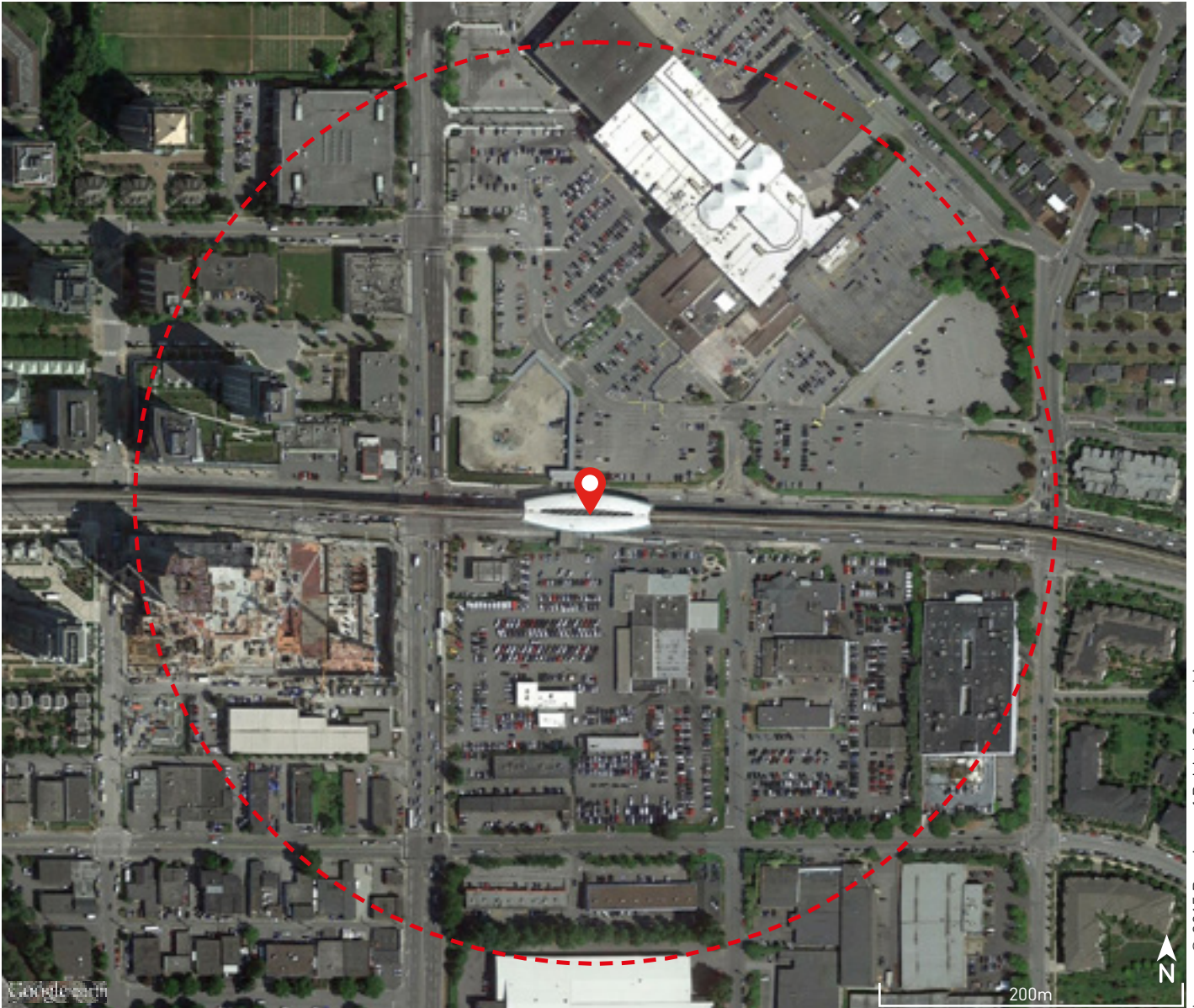
Figure I 20 Sabine Promenade hike and bike trails



Figure I 21 Temporal lunar lighting viaduct feature

Brentwood SkyTrain

Vancouver, Canada



The Brentwood Town Centre station is part of Metro Vancouver's SkyTrain rapid transit system. It is located directly above the highway and also serves as a pedestrian overpass. The station platforms are high above the roadway and the mezzanine and concourse are below the platform level. It is designed to provide a curved appearance and is built using a combination of wood and steel. The use of glass for the outer wall makes the station glow at night.

Image © 2015 Province of British Columbia



Figure I 22 Brentwood SkyTrain station architecture



Figure I 23 Brentwood SkyTrain view from street



Figure I 24 Brentwood SkyTrain architecture



Figure I 25 Brentwood SkyTrain Station entrance



Figure I 26 Brentwood SkyTrain Platform

Underpass Park

Toronto, Canada

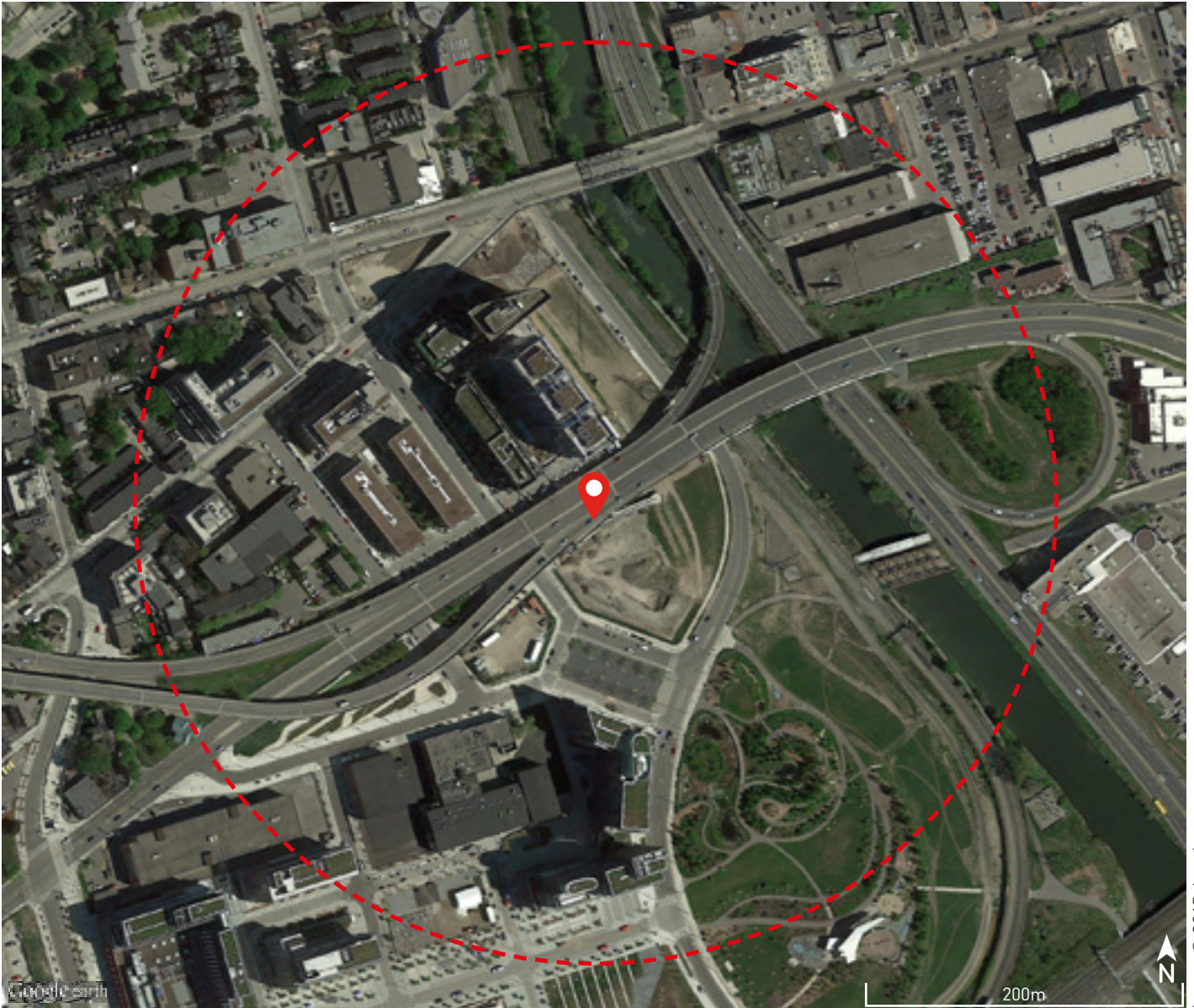


Image © 2015 Landsat

Underpass Park which was created in 2012 is one of the many initiatives by Waterfront Toronto aimed at revitalising public open space. The formerly underused space now features a playground, basketball courts and skate park.

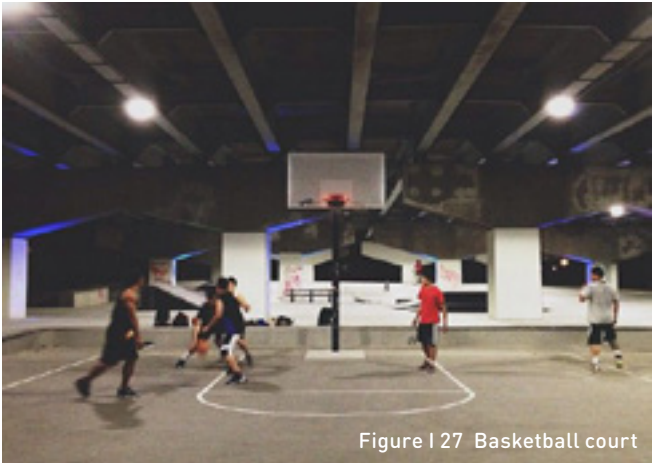


Figure I 27 Basketball court



Figure I 28 Event space



Figure I 29 Viaduct art



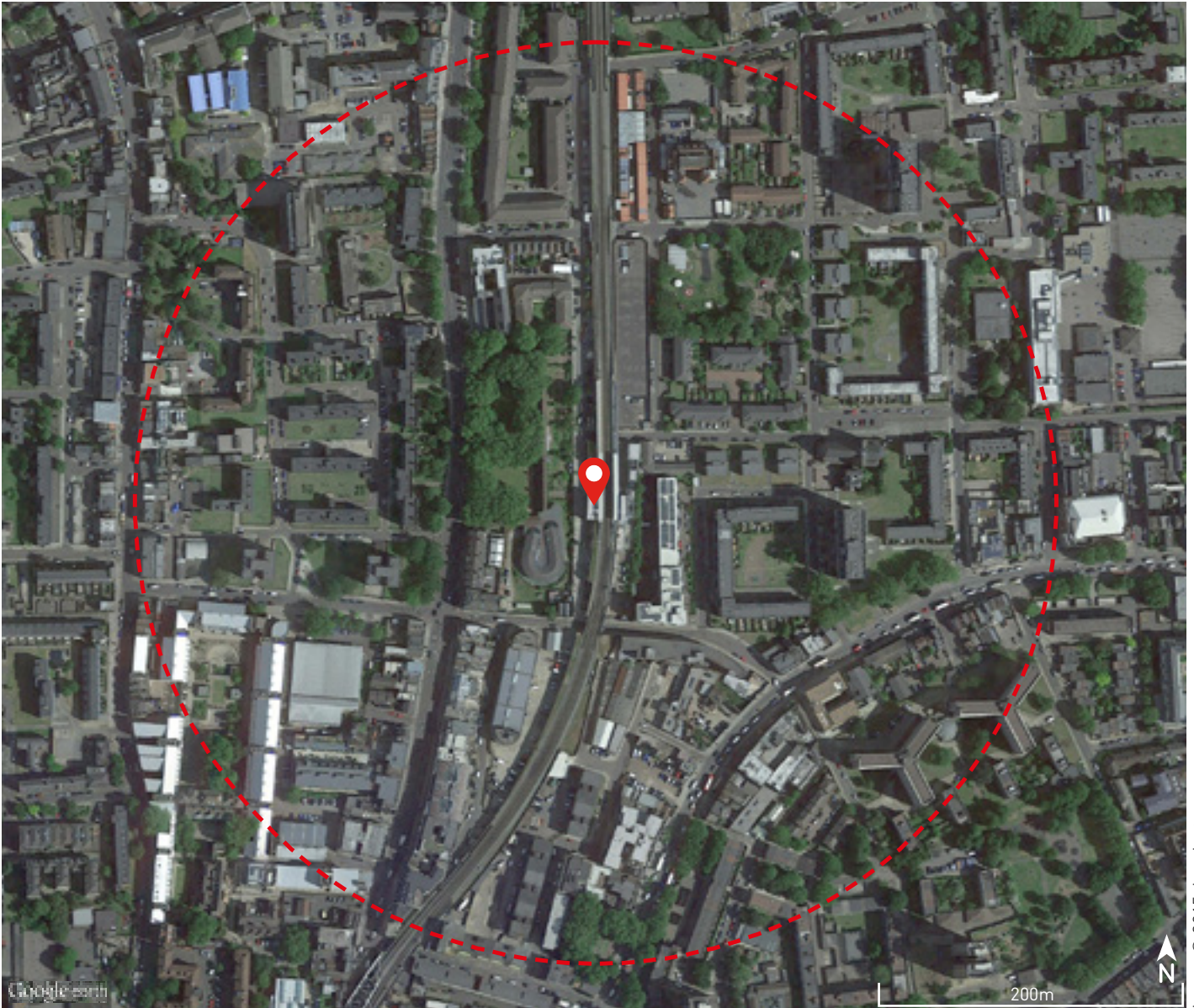
Figure I 30 Viaduct art



Figure I 31 Play spaces

Hoxton Station

London, UK



Hoxton Station was commissioned as part of the East London Line extension. Parts of the extension reused existing Victorian infrastructure and Hoxton station was inserted within the existing viaduct.

The project is an example of an re-purposed under viaduct space.



Figure I 32 Station entrance



Figure I 33 Station entrance



Figure I 34 Staircase



Figure I 35 Ticket gates



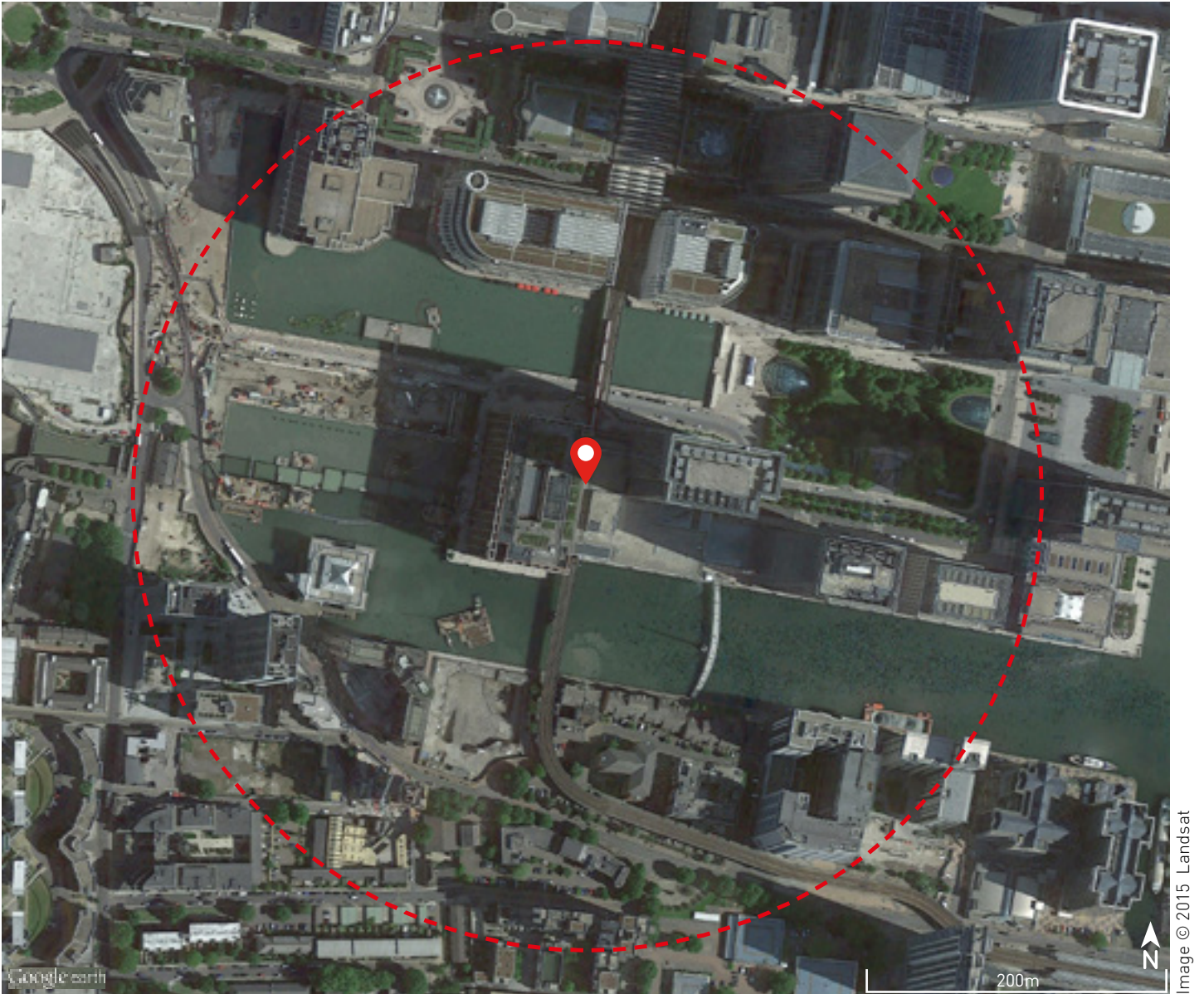
Figure I 36 Street frontage



Figure I 37 Restaurant under stain viaduct

DLR Heron Quays Station

London, UK



The new station, completed in 2002, was designed to be integrated within the Lehman Brothers building. The rail structure is wholly enclosed by the building above but is completely self supporting.

The station has space beneath the viaduct to encourage free flow for pedestrians and to emphasise the independence of the rail structure.



Figure I 38 Elevated rail

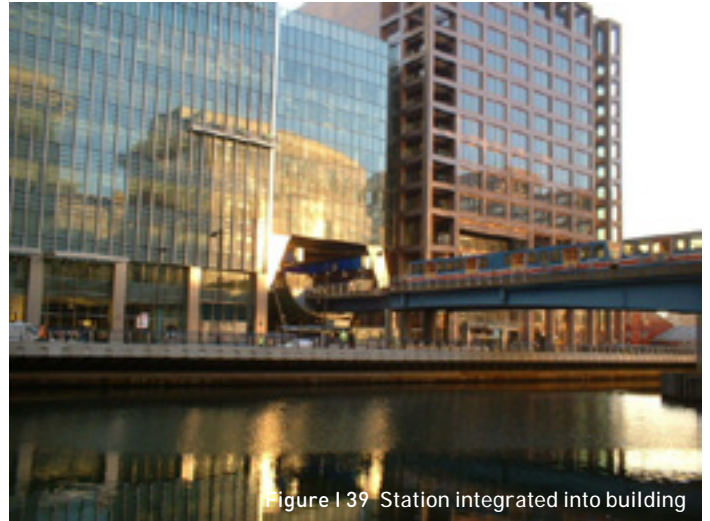


Figure I 39 Station integrated into building



Figure I 40 Space under the feature viaduct

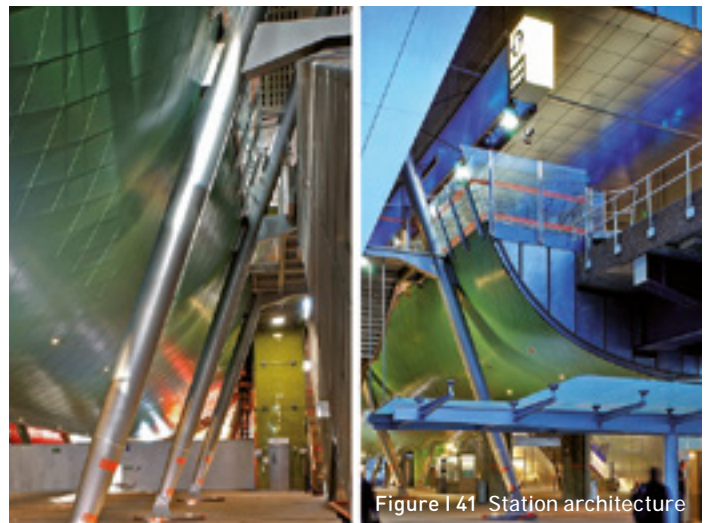


Figure I 41 Station architecture



Figure I 42 Platform

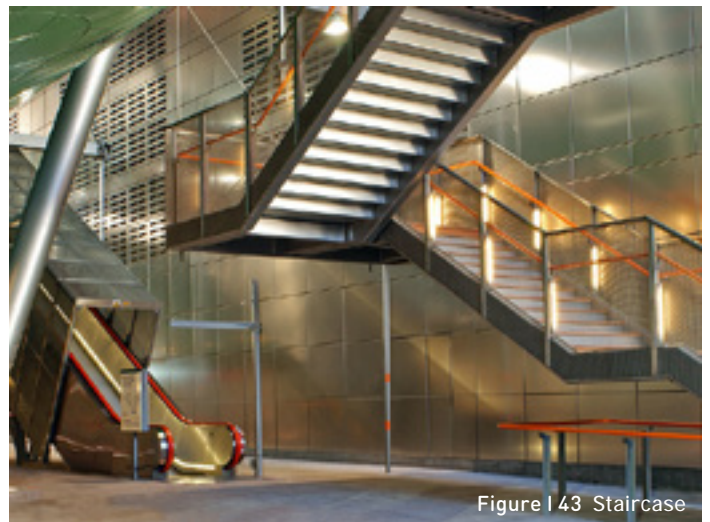


Figure I 43 Staircase

Folly for a flyover

London, UK



Folly for a Flyover was designed to transform a disused motorway undercroft in Hackney Wick into an arts venue and new public space.

This is an example of an urban design activation project.



Figure I 44 Activated space under motorway



Figure I 45 Folly for a Flyover



Figure I 46 Temporary cinema



Figure I 47 Temporary cinema



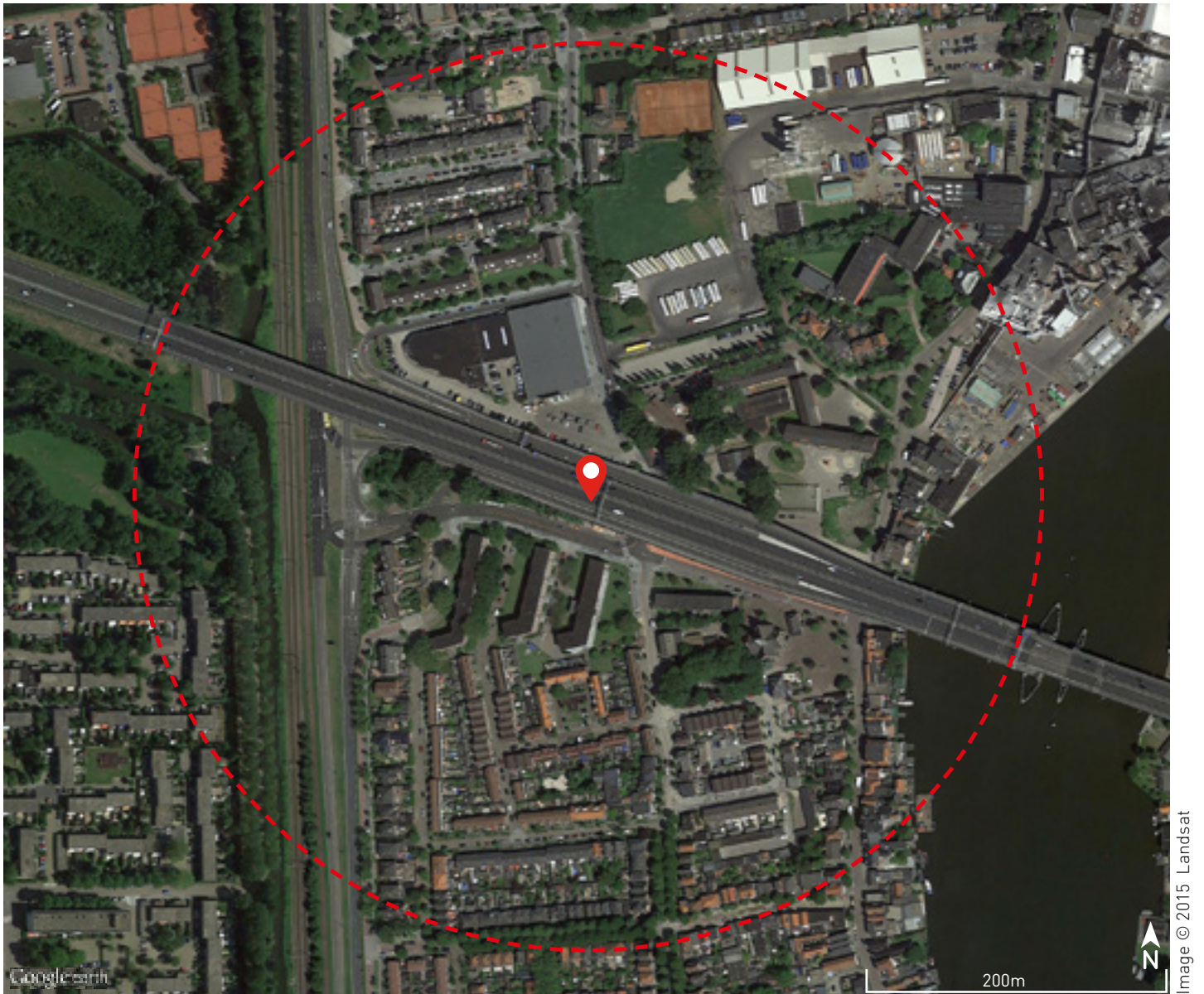
Figure I 48 View from the street



Figure I 49 Cafe outside building trapped between motorway

A8erna

Koog aan de Zaan, Netherlands



The A8 motorway bridge was built in the 1970's. It passes through Koog aan de Zaan and divides the local area. The A8erna project makes use of the space underneath the underpass with various different activities including a skate park, a plaza and a supermarket. The project reanimated the area below the underpass and established new connections.

The project is an example of activating a formerly forgotten space.



Figure I 50 Skate area



Figure I 51 The Panorama Deck



Figure I 52 The Panorama Deck and jetty



Figure I 53 Building underneath viaduct and feature piers



Figure I 54 Community space



Figure I 55 Basketball area

Randstad Rail Station Beatrixlaan

Den Haag, Netherlands

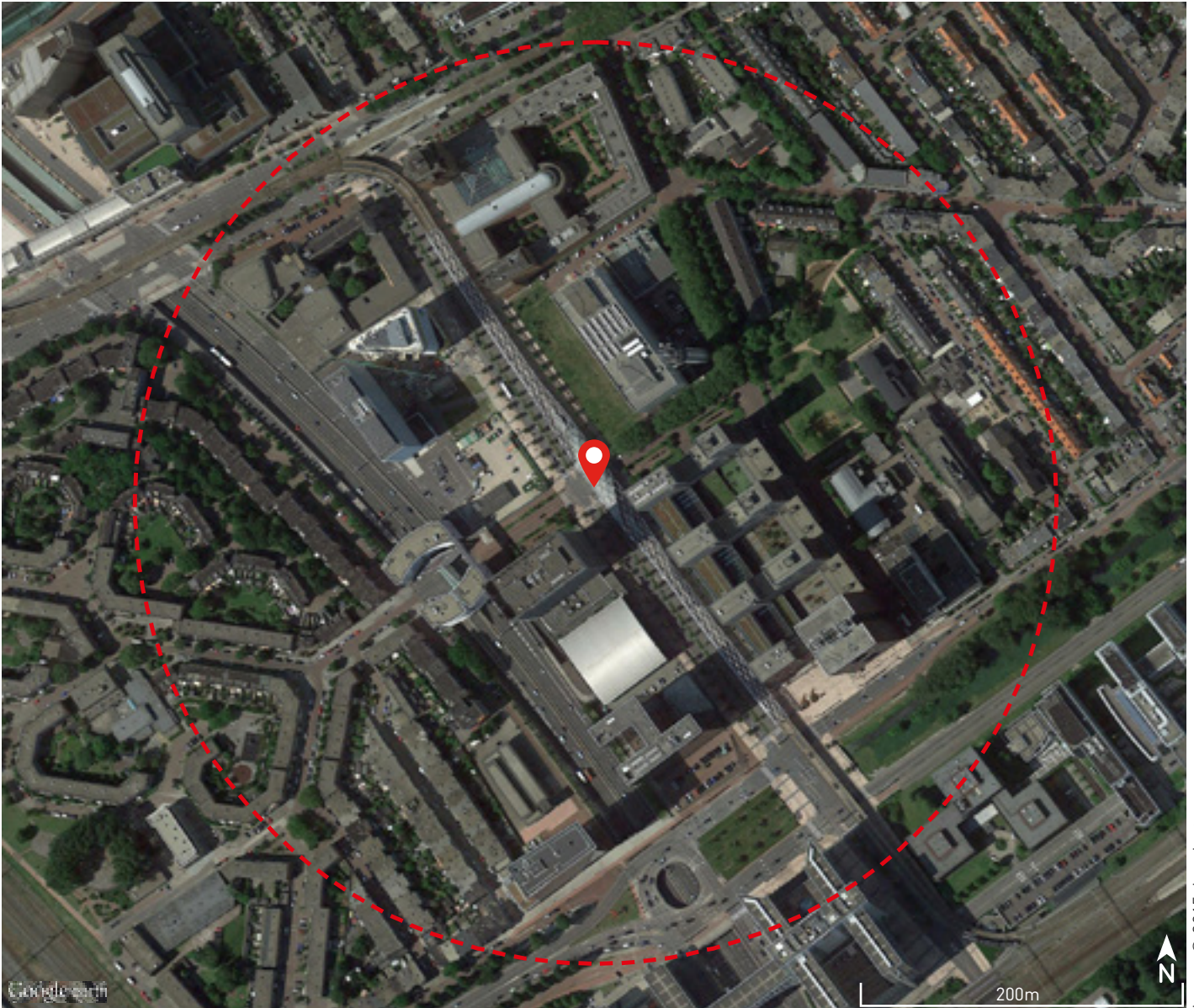


Image © 2015 Landsat

Located in The Hague, the Randstadrail is a light rail network through an urban setting. It is elevated on a 400m long viaduct over existing tram and railway tracks, with an elevated new station and platform.

The viaduct is wrapped in an open tubular space-frame structure which follows the curve of the train line.

There are relatively few columns at street level due to the 50m spans. The structure is permeable, allowing light and rain down into the landscape and the street below.



Figure I 56 Randstad Rail Station



Figure I 57 Randstad Rail



Figure I 58 Randstad Rail

Urban viaduct

Girona, Spain



The viaduct, built in 1973, has utilised landscape elements to present a softer, more welcoming appearance to the surrounding urban context.

Image © Data source: Institut Cartogràfic de Catalunya



Figure I 59 Vegetated viaduct



Figure I 60 Vegetated viaduct



Figure I 61 Vegetated viaduct



Figure I 62 Vegetated viaduct

Basarab Overpass Light Rail

Bucharest, Romania



Image © 2016 Landsat & DigitalGlobe 2016

The Basarab Overpass road opened in 2011 to connect Nicolae Titulescu blvd. and Grozavesti Road, part of Bucharest's inner city ring. The number 1 tram now runs along the elevated structure and follows the city's inner traffic circle.

The modern light rail stations are elevated on one of Europe's largest suspension bridges.



Refurbishment Viaduct Arches

Zurich, Switzerland

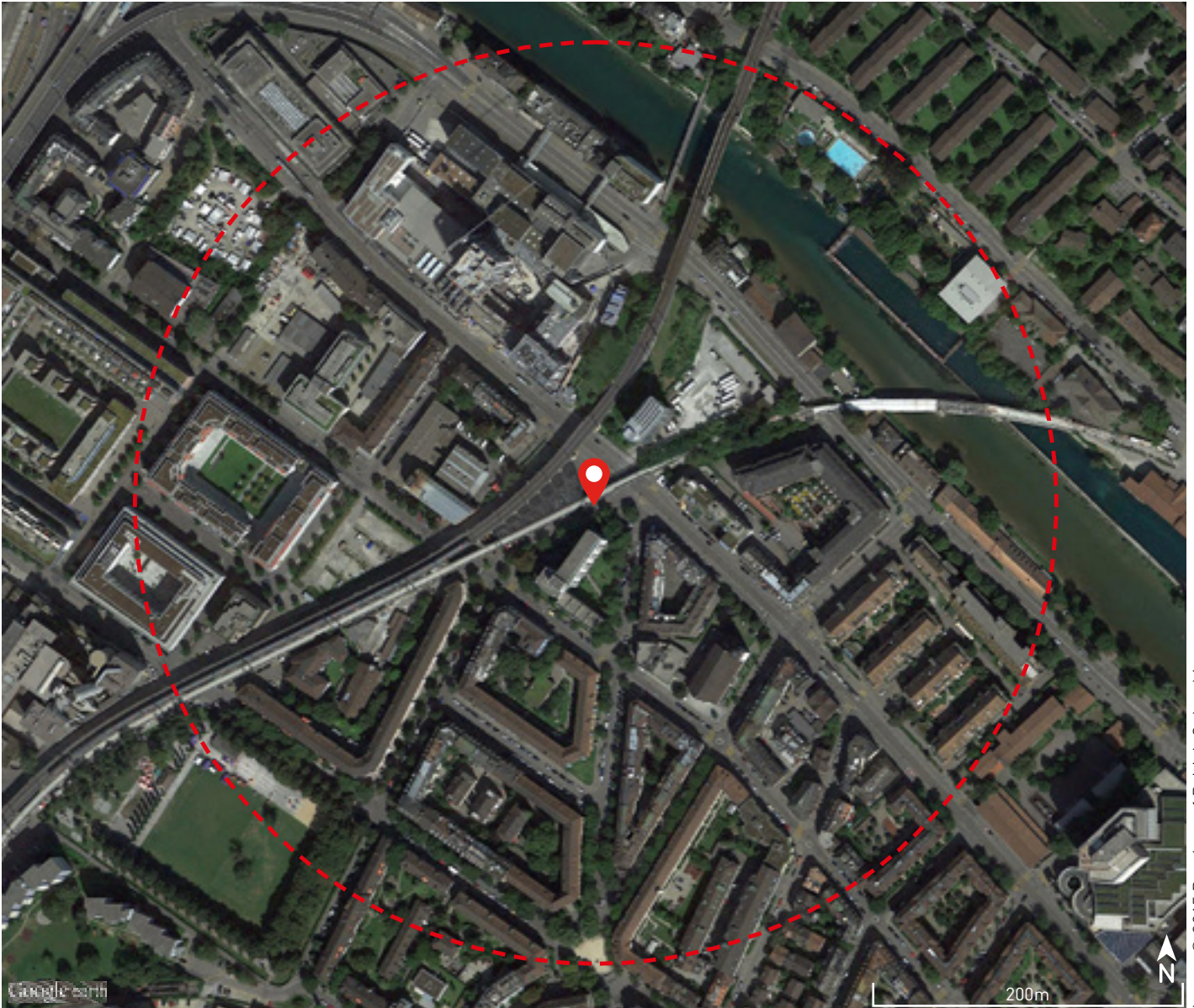


Image © 2015 Province of British Columbia

This project transformed the spaces under a historic 19th century rail structure into a cultural and commercial attraction. The viaduct which was originally built to support the city's early rail lines separated the parts of the inner city and Zurich city centre. Temporary and permanent buildings were installed in the viaduct structure to provide activity and amenity.



Figure I 68 Rail bridge and pedestrian bridge



Figure I 69 Rail viaduct



Figure I 70 Active frontages



Figure I 71 Active frontages



Figure I 72 Viaduct shops



NETWORK PRECEDENTS

Singapore MRT

Singapore



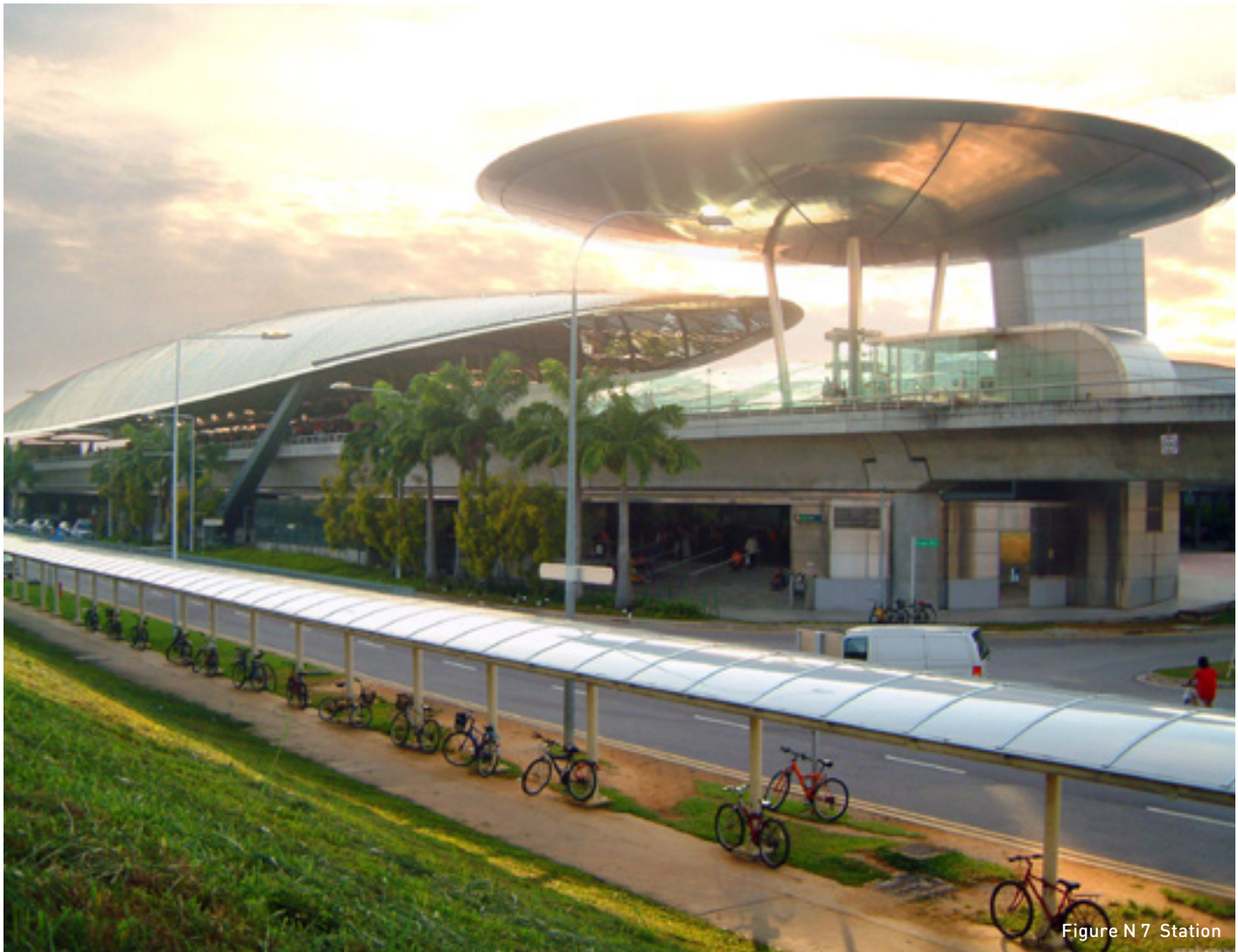


Figure N 7 Station



Figure N 8 Station



Figure N 9 Soccer facilities under rail viaduct



Figure N 10 Soccer facilities



Figure N 11 Open space around viaduct



Figure N 12 Soccer facilities



Figure N 13 Vegetation under viaduct



Figure N 14 Station



Bangkok BTS

Thailand



Figure N 19 Network map



Figure N 20 Aerial view



Figure N 21 Illuminated rail bridge



Figure N 22 Elevated viaduct



Figure N 23 Plaza and station



Figure N 24 Station



Figure N 25 Elevated rail



Figure N 26 Platforms-



Figure N 27 Elevated rail



Figure N 28 Station



Figure N 29 Street entrance



Figure N 30 Station



Figure N 31 Station building to the left



Figure N 32 Elevated rail



Figure N 33 Viaduct

RandstadRail light rail

The Hague, Netherlands

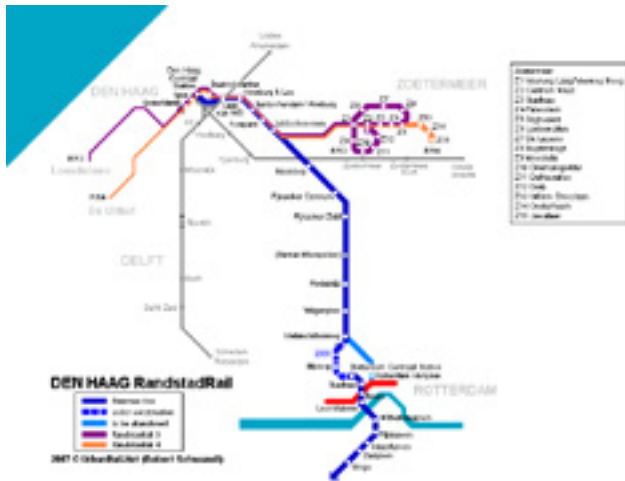


Figure N 34 Randstad Rail network



Figure N 35 Station



Figure N 36 Elevated rail

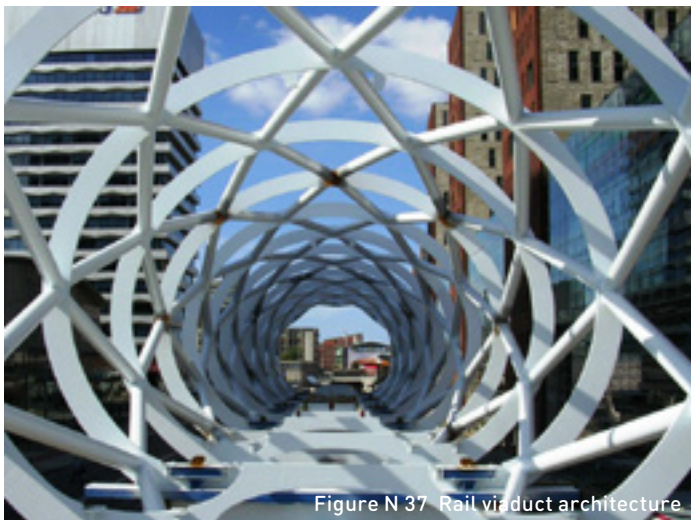


Figure N 37 Rail viaduct architecture



Figure N 38 Rail viaduct architecture



Figure N 39 Station



Figure N 40 Station



Figure N 41 Elevated rail



Figure N 42 Elevated rail



Figure N 43 Station

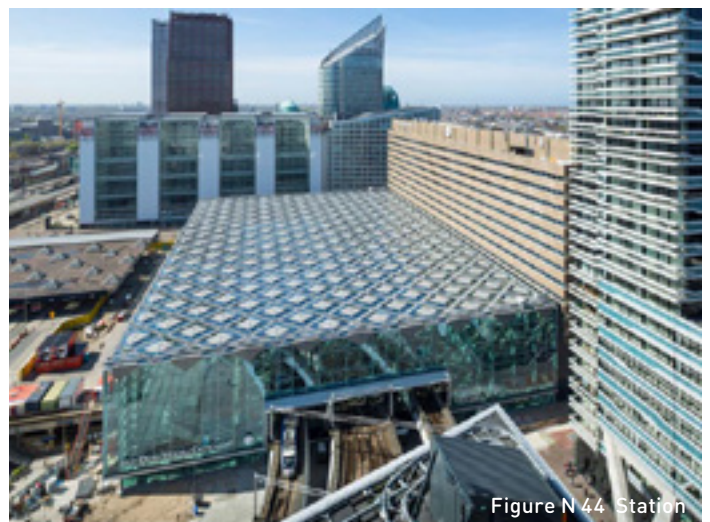


Figure N 44 Station

Dubai Metro

UAE



Figure N 45 Network map



Figure N 46 Elevated rail



Figure N 47 - Elevated rail structure



Figure N 48 Station



Figure N 49 Station



Figure N 50 Station



Figure N 51 Station



Figure N 52 Station interior



Figure N 53 Station



Figure N 54 Rail bridge



Figure N 55 View from elevated rail

Miami MetroRail

USA



Figure N 56 Network map



Figure N 57 Elevated rail



Figure N 58 Station



Figure N 59 Station



Figure N 60 Station



Figure N 61 Station



Figure N 62 - Artist's impression of Miami Station



Figure N 63 Elevated rail



Figure N 64 Elevated rail



Figure N 65 MPath Coconut Grove under the MetroRail



Figure N 66 MPath Dadeland under the MetroRail



Figure N 67 MPath University of Miami under the MetroRail



Figure N 68 MPath South of Brickell next to the MetroRail



Figure N 69 MPath Brickell under the MetroRail



Figure N 70 Typical Trail next to the MetroRail



Figure N 71 MPath Ponce de Leon under the MetroRail

Vancouver SkyTrain

Canada

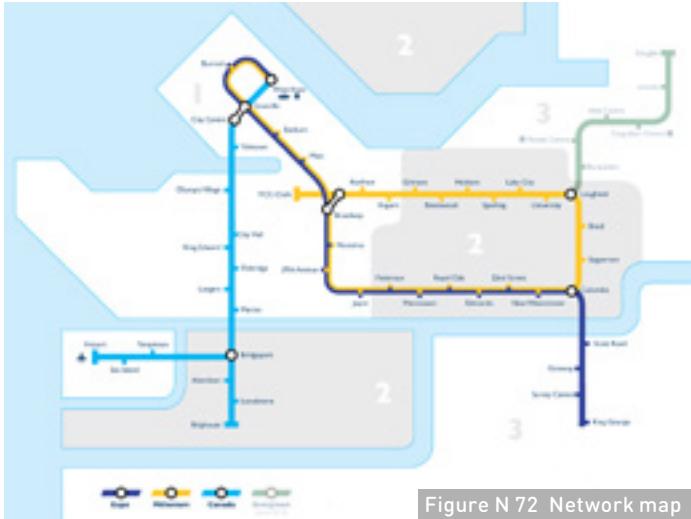




Figure N 78 Elevated rail



Figure N 79 Station



Figure N 80 Station



Figure N 81 Station



Figure N 82 Green wall



Figure N 83 Station

Jubilee Line Extension London



Figure N 84 Stratford Station



Figure N 85 Stratford Station



Figure N 86 Stratford Station



Figure N 87 Canada Water Station



Figure N 88 Canada Water Station



Figure N 89 Canary Wharf Station

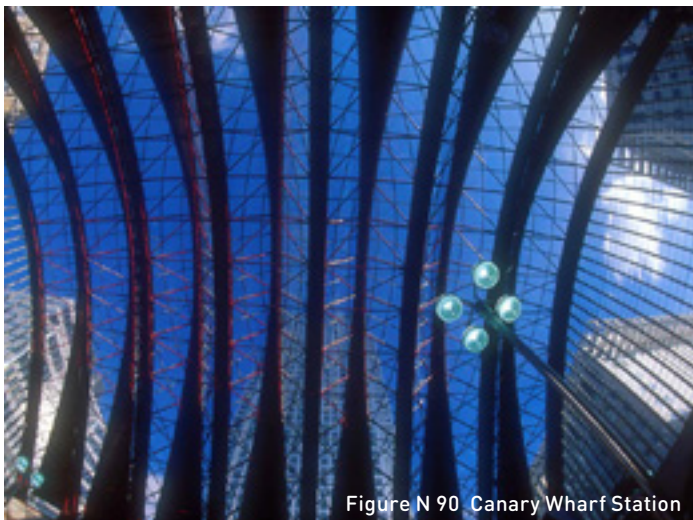


Figure N 90 Canary Wharf Station



Figure N 91 Canary Wharf Station

Jubilee Line Extension London



Figure N 92 Canary Wharf Station



Figure N 93 Canary Wharf Station



Figure N 94 North Greenwich Station



Figure N 95 London Bridge Station



Figure N 96 Westminster Station



Figure N 97 Southwark Station



Figure N 98 Southwark Station

Montreal Metro

Canada

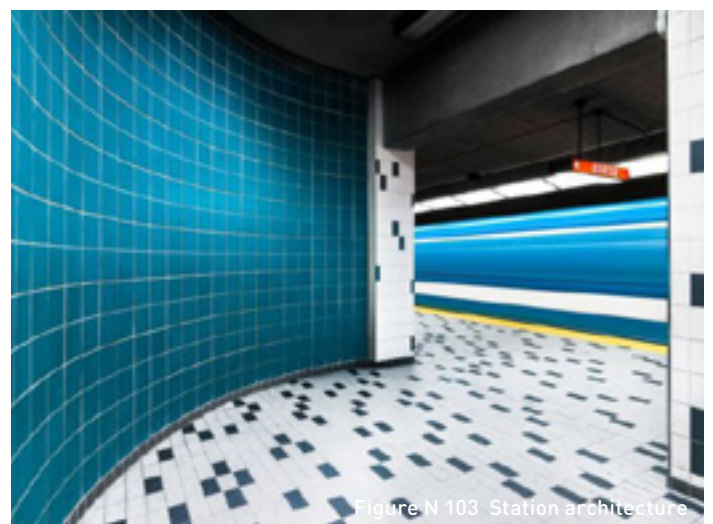
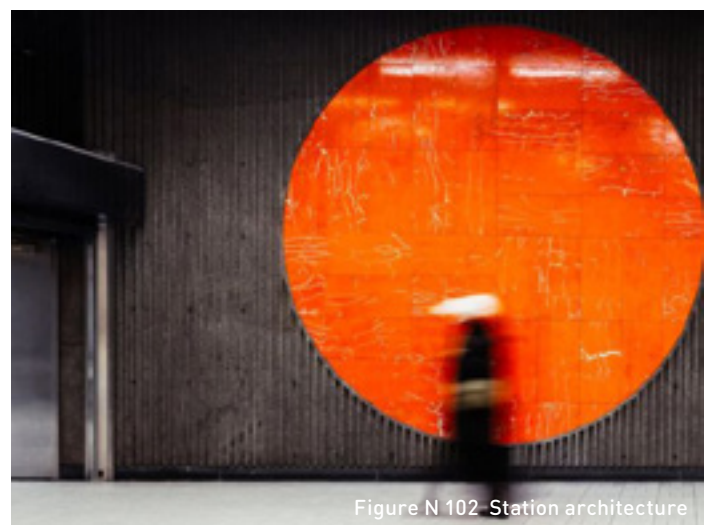




Figure N 104 Station artwork



Figure N 105 Station architecture



Figure N 106 Station architecture

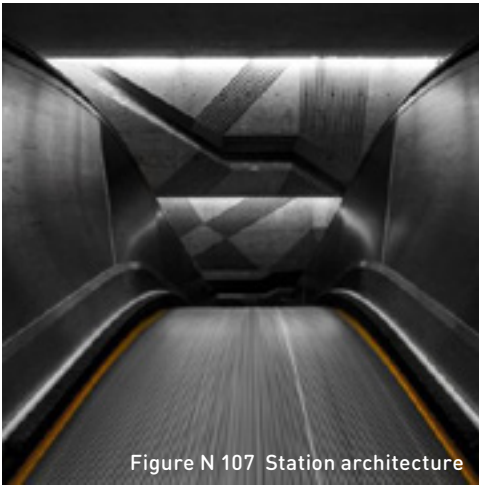


Figure N 107 Station architecture



Figure N 108 Station artwork

Montreal Metro

Canada

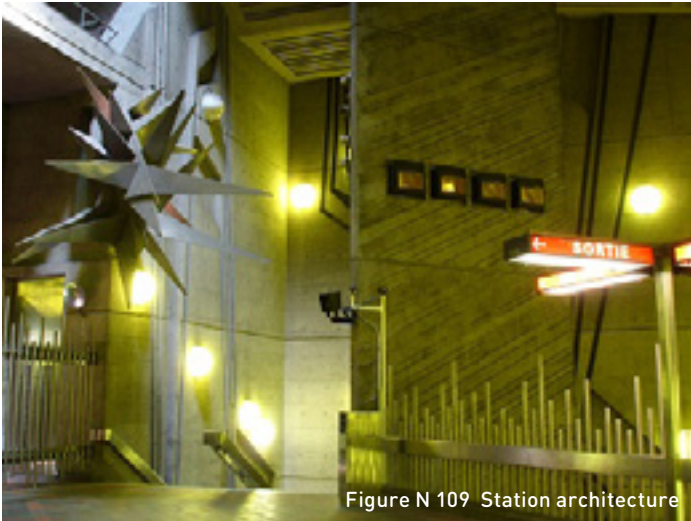


Figure N 109 Station architecture

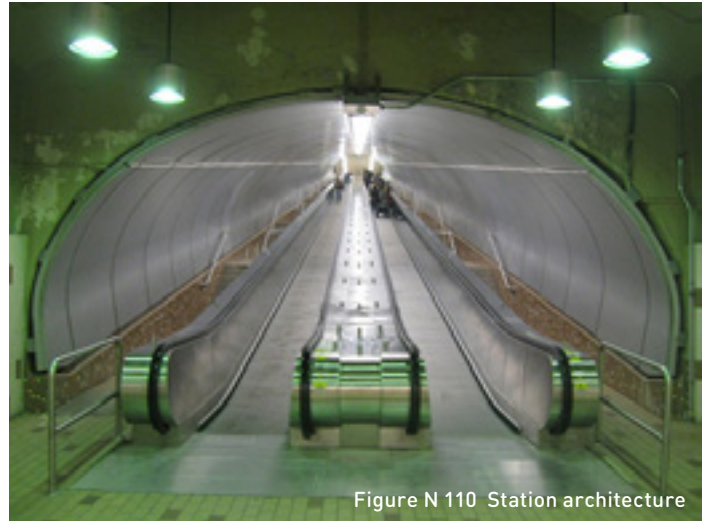


Figure N 110 Station architecture

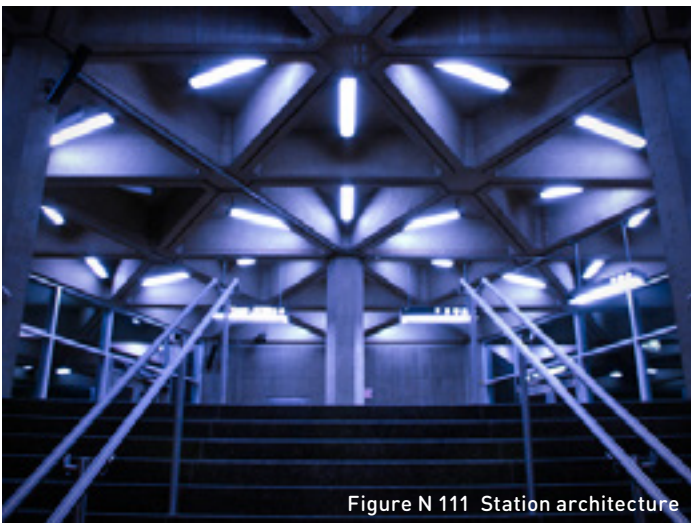


Figure N 111 Station architecture



Figure N 112 Station architecture



Figure N 113 Station architecture



Figure N 114 Station architecture



Figure N 115 Station architecture



Figure N 116 Station architecture

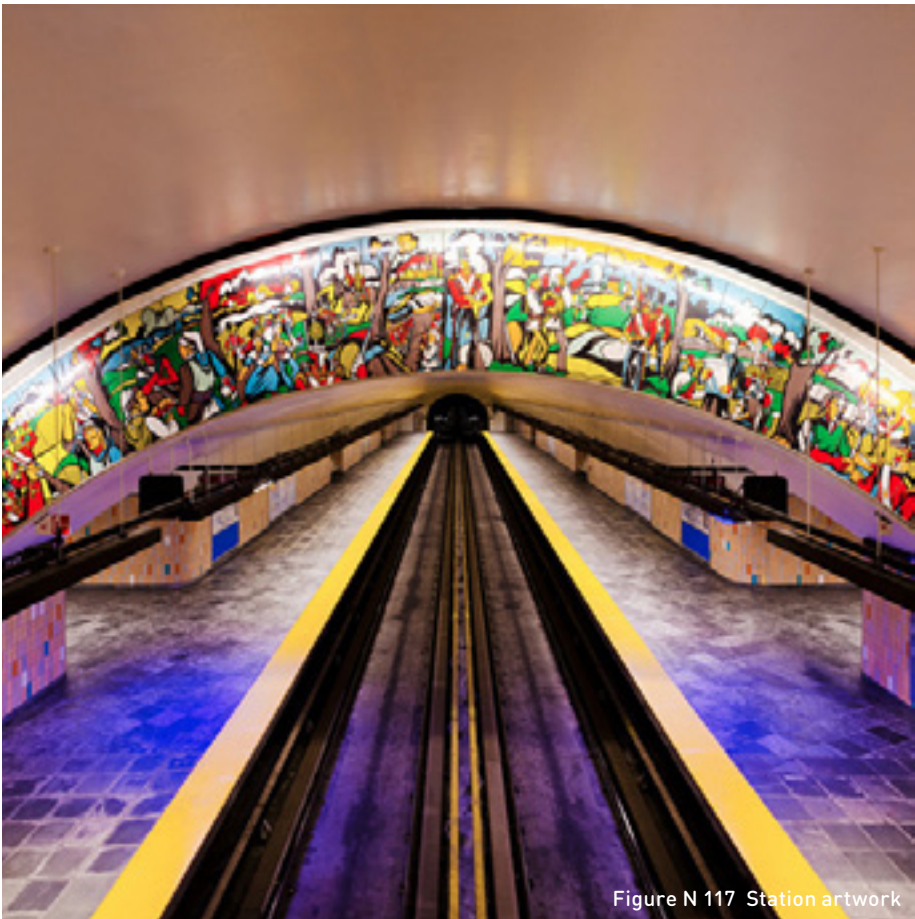


Figure N 117 Station artwork



Figure N 118 Platform seating

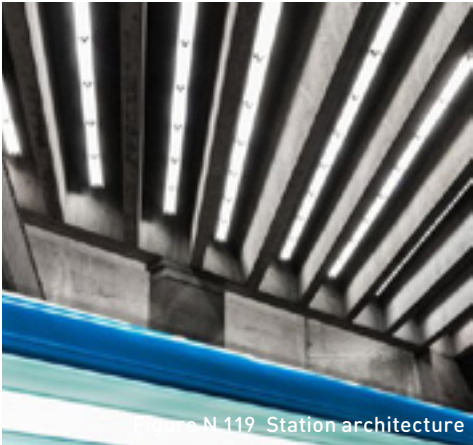


Figure N 119 Station architecture

Regional Rail Link Melbourne



Figure N 120 Network map



Figure N 121 Wyndham Vale Station



Figure N 122 Tarneit Station



Figure N 123 Footscray Station



Figure N 124 Sunshine Station



Figure N 125 Sunshine Station



Figure N 126 West Footscray Station



Figure N 127 Tottenham Station



Figure N 128 West Footscray Station

Sydney Metro Northwest Skytrain

Sydney





Figure N 132 Artist's impression of elevated station



Figure N 133 Artist's impression of commuter views



Figure N 134 Artist's impression of open space under viaduct

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